ELECTRICAL REVIEW

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IN THIS ISSUE

Trade with America	**269**
High-Voltage Laboratory	**271**
Toronto System Changes	**274**
New Books	**275**
Mercury Arc Convertors. By J. P. Wolfenden, M.Sc., M.I.E.E.	**276**
Engineering in Europe	**282**
Views on the News	**283**
Personal and Social	**285**
Constitution of the B.E.A.	**287**
Parliamentary News	**289**
Electricity in South Africa. By Harold J. Beard, B.A., M.I.E.E.	**291**
Naval Gas Turbine	**293**
Electricity in Mines	**295**
Contracts and Sales. By C. F. Mayson, A.M.I.E.E.	**297**
Correspondence	**300**
Sealing Metal to Glass. By R. H. Warring	**301**
Recent Introductions	**305**
Commerce and Industry	**307**
Electricity Supply	**311**
Financial Section	**313**
Canadian Imports	**316**
New Patents	**317**
Contract Information	**319**
Classified Advertisements	**121**
Index to Advertisers	**132**

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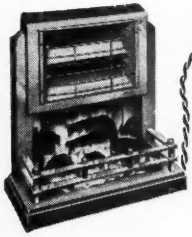

THE FIGURES

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ELECTRICAL REVIEW 8th AUGUST, 1952

THE OLDEST ELECTRICAL PAPER • ESTABLISHED 1872 • VOL. CLI • NO. 3898

Trade with America

MEMBERS of the past and present Governments have long been urging upon industrialists the imperative need of earning dollars to redress the unsatisfactory exchange position into which this country was forced by the war. Some have been quite optimistic about the possibilities of exporting goods to the United States; some have been more cautious, but all have recognized that any success can only be attained by continued intensive study and cultivation of the territory. British exporters are only too anxious to exploit dollar markets but they must feel that the work they put in will not be neutralized by the unwillingness of American manufacturers to see them succeed. Although it has been stated that the dollar-sterling balance could be righted by permitting Great Britain to supply an extremely small proportion of American requirements, it is natural that American industries likely to be affected are not willing to lose part of their trade to us, however much the United States Government is on our side.

The problems were put to the American Chamber of Commerce in London recently by the President of the Board of Trade. Mr. Thorneycroft regretted the height of the American tariff barriers, the complicated Customs procedure and other handicaps to British trade and asked the Americans to allow free and fair competition. Further references to the subject were made by Mr. Leslie Gamage, when he was addressing a meeting of the Institute of Export, of which he is president. Mr. Gamage bluntly said that the United States was not a " natural " market for most British goods. He advocated concentration of attention by exporters upon the British Commonwealth countries which were much more likely markets.

British electrical equipment can occasionally be sold in the United States as the recent Ferranti transformer contract has proved—and, of course, there have been earlier instances. It has also proved that the way is not smooth; acceptance of offers at

very attractive prices is by no means automatic. In this case the successful tenderers were favourably placed. They had established representation in New York and a Canadian associate able to provide any necessary service far more rapidly than a concern operating entirely from this country. The conclusions seem to be that at present only companies with an existing hold on the market are likely to secure orders and that unless the United States Government can persuade its own people that it is good policy to refrain from putting obstacles in the way of British exporters others stand little chance of succeeding.

B.E.A. APPOINTMENTS

Even the opponents of the principle of nationalization must agree that the way in which the electricity supply industry has been converted into a national organization from about 600 separate undertakings deserves commendation. They may even share with those who now accept the principle the gratification felt at the reappointment of all except two of the members of the British Electricity Authority. It is greatly regretted that age and illness respectively have led to the loss of Sir William Walker and Mr. E. W. Bussey, who have both taken a big share in the arduous labour of the past five years. We wish Lord Citrine and his colleagues (including Mr. J. Sullivan, the new member) the maximum of health and strength in the continuance of their valuable work.

SMALL GAS TURBINES

Gas turbines lend themselves, especially in small ratings, to so many variations in their set-up to meet extremes of conditions that they furnish rare opportunities for exercise of practical ingenuity in designs. There are many indications, as our columns have shown, that full advantage is being taken of these opportunities. The Royal Navy has departed happily from its reputation for silence in permitting the demonstration at the maker's works of a 1,000 kW set, particulars of which are given in this issue.

CONSUMER GOODS

An indication of the trend of electrical production is given in the report for 1951–52 of the General Electric Co., Ltd. The company's production reached a record level but it is shown that the increase was accounted for by the greater demand for capital goods. There was a steep fall in orders for consumer goods during the latter part of the year and the fall continues, both at home and abroad. No explanation is given (it will probably form part of Sir Harry Railing's speech at the annual meeting in September) but some factors are obvious. At home, discouragement of the domestic use of electricity combined with curtailed purchasing power can be blamed. Overseas, import restrictions have fallen most heavily on consumer goods which, in any event, some countries can produce for themselves. We can remedy the home situation and this in itself may enable us to compete in unrestricted overseas markets.

ENGINEERING WAGES

As was anticipated, the engineering employers have told the Confederation of Shipbuilding and Engineering Unions that they are unable to concede the unions' claim for a wage increase of £2 a week. Although there has been a rise in the cost of living since the last increase was granted in 1951, it has not been sufficient to justify what even some trade union leaders considered to be a somewhat extravagant demand. No alternative offer was made by the employers but it was said on their behalf that they were willing to reward increased effort by individual workers.

High-Voltage Laboratory

New Testing Facilities at Loughborough

ELECTRICAL plant has been manufactured by the Brush Electrical Engineering Co., Ltd., for more than a century. The largest power transformers it has so far built have been of 30 MVA for operation at 132kV, the prototype having been tested at the National Physical Laboratory at the 640/750 kV impulse level.

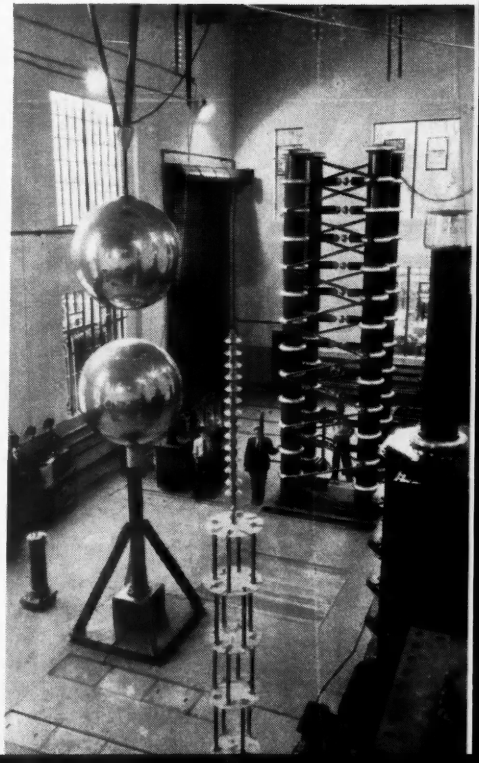
The rapidly increasing physical size of plant of this type is making it both costly and inconvenient for manufacturers to transport their products to and from Teddington for acceptance testing. Makers are additionally needing to have their own means of determining the effects of transient voltage surges, both atmospheric and switching, at the higher voltages now being employed for power transmission. Hence the establishment at the Falcon Works, Loughborough, of a new laboratory for testing completed transformers both for acceptance and for investigation, as well as for research into insulating substances and assemblies of insulating materials.

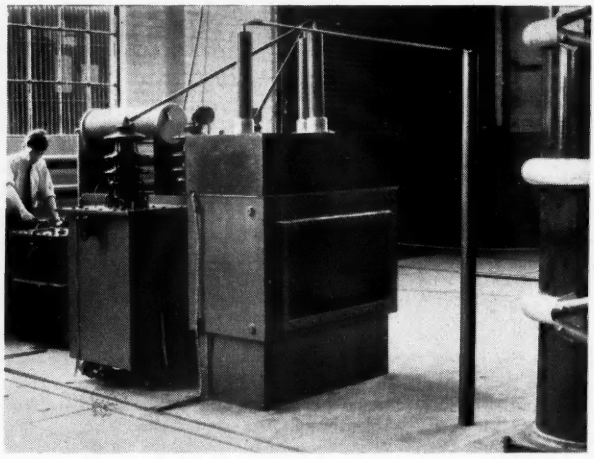
The laboratory was formally opened last week. After luncheon in the works canteen, at which Mr. J. W. C. Milligan, managing director, presided, Mr. H. E. Midgley, a director, introduced Sir Ben Lockspeiser, secretary, Department of Scientific and Industrial Research, who said that the building and equipping of a high-class laboratory was not an easy task, for before this century was out many unexpected advances would have been made. It was their business to ensure that sufficient of those technological innovations were made in this country, originating in laboratories such as the one he was then inaugurating, and it was because he believed that aim to be so important to this country's industrial economy that he found pleasure in performing the opening ceremony.

In an industrial country such as ours, electrical power was a predominant factor that affected the nation's well-being. Electrical power was the key to industrial power, so economies in its generation, high efficiencies in transmission, and reduction of avoidable waste caused by breakdown, were among the immediate objectives of a high-voltage laboratory.

But Sir Ben hoped that the laboratory would not confine itself to tests, essential though they were. Already the study of problems of insulation strength had led to valuable developments in other branches of physical science: for instance, van der Graaf generators and electron microscopy. It was of first importance that a due proportion of effort should be devoted to fundamental inquiry to maintain the "scientific capital" of the subject which provided, by the accumulation of know-

General view from the observation gallery of the high-voltage testing laboratory at the Falcon Works, Loughborough





Charging transformer and voltage-doubling "Westalite" rectifier with polarity-changing and earthing switches

ledge, not only the surest basis he knew of for the solution of the problems of the future, but also the "intellectual climate" which promoted discovery and the growth of new ideas. It was particularly there that they must not fail. Revolutionary advances in science were often unexpected; while they were patiently exploring and breaking new ground they must keep a sharp eye open for new possibilities which might be thrown up, whether they were immediately concerned with them or not. His advice was: "Don't keep your noses too close to the grindstone; allow something for scientific adventure, which might be priceless."

The testing equipment is housed in an extension of an existing building. The laboratory is 80ft long by 40ft wide and 40ft high. At one end a rail track runs the full width of the building so that large transformers can be taken into the laboratory. At each end of the rail track is a roller shutter door, one to give access to the factory production bay and the other opening to an off-loading area outside the building.

At the opposite end of the building is a two storey administrative block; on the first floor are a 50 c/s control room, an impulse generator control room and a small records room; and on the second floor are an office, a conference room and a dark room. Across the full width of the laboratory at this end is an observation gallery at second floor level.

The main items of equipment are a twelve-stage impulse generator, each stage comprising two 0·12 μF condensers connected in parallel, giving an output capacitance of 0·02 μF. The charging voltage is 125 kV per stage, derived from a Cockcroft-Walton voltage doubling circuit delivering a total output, with all stages connected in series, of 1,500 kV. The stored energy at peak voltage is 22·5 kW-seconds. The capacitors were supplied by the Telegraph Construction & Maintenance Co., Ltd.

The circuit is arranged so that stages can be connected in various groups of series-parallel arrangements. The main tripping gaps are mechanically coupled and driven through eccentric cams by a small geared motor which is controlled from a distance. Gap setting is also remotely indicated on the main control board. The auxiliary tripping circuit is a Miller needle gap with variable switched time delay in the pulse circuit to the needle gap, giving an overall delay range of from 0·5 to 25 microseconds.

Voltage recording is by a matched resistance-capacitance divider, the low voltage arm of which is wired back to the main impulse generator control board. Voltage measurement is by a 150 cm sphere gap assembly, the spheres for which were supplied by the London Aluminium Co. of Birmingham. The insulated sphere is fixed and is suspended from the roof girders by three insulated rods terminating in a stress cone just above the high voltage sphere. The earthed sphere is movable and driven by a geared motor through a range up to 0·75 diameter at about 90 cm. The gap setting is remotely indicated on two indicators on the control board, one

covering 0–120 cm and the other 0–10 cm.

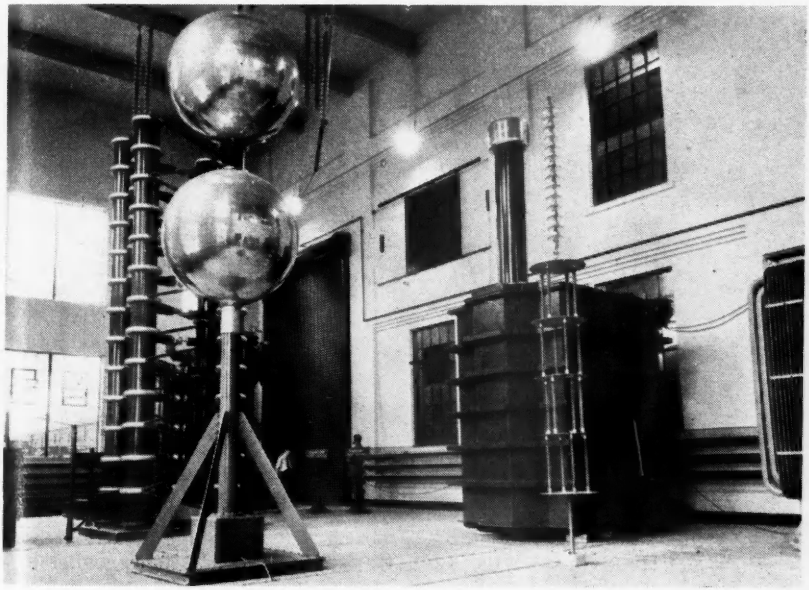
High voltage at 50 c/s is obtained from a 2,000 kVA, 3·3/500 kV, oil-immersed, double-wound Brush transformer, the 3·3 kV winding being energized by a 2,000 kVA test alternator housed outside the building. The h.v. winding has a cascade winding at the output end, wound for 3·3 kV to permit future extension up to 1,000 kV. The special h.v. bushing was supplied by the Micanite & Insulators Co., Ltd.

Power factor and capacity measurements will be made with a Schering bridge by the Cambridge Instrument Co. and a compressed-gas h.v. standard condenser of 150 kV and unity power factor at 50 c/s. This capacitor was supplied by the Micafil concern, Zurich.

The entire equipment in the laboratory is interconnected by $1\frac{1}{4}$in outside diameter aluminium tubular busbars mounted on strings of glass insulators suspended from the roof; small hand winches facilitate raising and lowering for interconnection. The main panel for all the equipment is in the control room and carries all the indicating circuits, master " make-dead " and " make-alive " switches, polarity changeover switch control, voltage regulating circuit for the main supply transformer to the generator, sphere gap " raise " and " lower " control and gap indication, and four high speed oscillographs built in accordance with the N.P.C. circuit. Each consists of a single 10 kV cathode-ray tube of the 908 B.C.C. type and a camera by Southern Instruments with a f1·5 lens for recording on 35 mm film with sweep speeds of from 0·5 to 250 micro-seconds. Each recorder is mounted in a movable rack to enable it to be used in any part of the laboratory. The construction is such that each separate circuit group is mounted on an individual chassis fitted into the rack on runners, interconnected at the back by a plug arrangement so that each unit can be withdrawn from the front for servicing.

Safety precautions include master " make-dead " and " make-alive " buttons, duplicated on each section of the control panel, together with a " make-dead " switch on the observation gallery. All the main doors into the laboratory are electrically interlocked so that when opened

Aluminium sphere gap in front of 1·5 MV impulse generator with (left) its Westinghouse charging rectifier and (right) a 500 MV, 2,500 kVA flash-testing transformer



the impulse generator is made dead and earthed.

The entire installation was designed by the Brush transformer engineering development staff after discussions with the National Physical Laboratory, the British Electrical and Allied Industries Research Association and Queen Mary College as well as visits to these organizations and to industrial equipments in this country, on the Continent and in America.

Mr. R. M. W. Grant demonstrated several ways in which the new equipment was to be employed.

Toronto System Changes

Frequency Standardization and Cable Laying

CAPITAL construction works in Toronto have expanded steadily in recent years and last year's expenditure of $4·8 million represented a sevenfold increase over 1945. Two costly projects are in hand—frequency standardization and the substitution of underground cables for overhead lines.

At the beginning of 1951 plans were approved for installing 13·2 kV, 60 c/s cables and equipment sufficient to supply all the present 13·2 kV consumers, but because of the requirements of the defence programme the work of conversion has been retarded. On the advice of the Provincial Commission the frequency standardization has since proceeded on the basis of affording 60 c/s supplies to new consumers and those making additions to their plant. At the end of the year the total load served at 60 c/s was 20,760 kW.

While the frequency standardization plan is being carried out some 45,000 consumers whose equipment has already been standardized will, it is estimated, move into the 25 c/s area. To solve this problem it was arranged to provide 4 kV primaries and transformers having a capacity of 70,000 kVA, together with a pair of secondaries for system-wide distribution of a 120/240 V 60 c/s single-phase supply. The total cost is estimated at $3·8 million. Orders were placed for 60 c/s rectifier equipment to replace the 25 c/s rotaries supplying the Toronto Transportation Commission.

With regard to the second important scheme, that of placing the overhead lines underground, the Commissioners' report shows that a complete underground system would cost in the region of $225 million, which would place a very considerable burden on the System's finances, apart from which the concrete poles carrying the secondaries are needed for street lamps. Removal of the primaries would cost $45 million and for the present it is proposed to finance the work out of net income as available. During 1951 underground construction valued at about $1·4 million was completed, part of which was in place of overhead equipment. The Commissioners say that while they appreciate the desirability of this work, its importance must be weighed against that of other tasks. To ensure continuity of service it is essential to reinforce the plant to meet the extraordinary expansion of demand. It is also necessary to reconstruct the underground plant on Front Street and that part of Yonge Street disturbed by the Subway.

In 1951 the System sold 2,061·8 million kWh compared with 1,915·4 million in the previous year, the annual peak load rising from 420,203 to 421,584 kW. Gross operating income amounted to $21·8 million and most of the surplus of $1·7 million was allocated to frequency standardization.

B.B.C. Summer School

SOME 40 professors and lecturers from 21 universities and technical colleges in Great Britain and Northern Ireland took part in a Summer School at the B.B.C. Engineering Training Department, Wood Norton, near Evesham, from 14th to 18th July. The object was to give teachers in electrical engineering an opportunity to hear about the methods used for broadcasting sound and television and to take part in informal talks with B.B.C. engineers and the heads of some of the programme departments. Lectures were given by senior members of the Engineering Division on the work of the Research and Designs Departments, and of the Operations and Maintenance Departments. The training methods used in the Engineering Division were described by the head of the Engineering Training Department, Dr. K. R. Sturley, and a number of demonstrations were given in the laboratories. Visits were paid to the transmitting stations at Daventry and Sutton Coldfield.

In addition, there were lectures on audience research, on the broadcasting of drama and on feature programmes, by the heads of the departments concerned. The Summer School ended with an informal discussion under the chairmanship of the deputy chief engineer, Mr. R. T. B. Wynn (who became chief engineer on 1st August).

NEW BOOKS

The Magnetron. By R. Latham, M.A., Ph.D., A. H. King, M.A., and L. Rushforth, B.Sc., M.I.E.E. Pp. 142; figs. 82; index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 18s.

During the 1939–45 war the authors of this book were members of the research staff of the B.T.H. Co. engaged on the Services magnetron programme. The first two chapters give a very brief sketch of radar techniques and of other types of u.h.f. oscillator. Chapter 3 deals with the history of the multi-resonator magnetron. The study of modern magnetrons then starts with a chapter on the behaviour of the anode block, considered as a chain of lumped constant resonant circuits. Next, the coupling of the block to the load is considered. Chapters 6, 7 and 8 deal with the electronic theory of threshold voltage, energy conversion and mode stability. Cathodes, construction and testing are each given a short chapter, and the book concludes with a summary of the uses of magnetrons in radar. The book is well illustrated and contains a large number of references to original papers, many of which are unpublished Government reports.

The book is lucid and, as one would expect from the authors, well informed. The impression it leaves is, however, not entirely satisfactory. At least one-fifth of the book contains elementary material not germane to the main subject which is surely familiar to all likely readers. The space gained by pruning this away could have been used to describe post-war developments which the authors have completely neglected. On the other hand, the book is the first to show what was done on the subject in this country between 1939 and 1945, and is thus a valuable supplement to existing works.—A.H.B.

Foundations of Electrical Engineering Vol. I. By H. Cotton, D.Sc., M.I.E.E. and E. W. Golding, M.Sc.Tech., M.I.E.E. Pp. 301; figs. and index. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 20s.

This is the first of two volumes designed to cover the syllabus for the examination in electrical engineering for the Ordinary National Certificate. The authors recognize that in any college course designed to prepare students for this examination, the field to be covered must be so wide if the approval of the Institution of Electrical Engineers is to be obtained, that it could not be satisfactorily dealt with in a single volume of reasonable cost and size. Hence, in the volume under review they have dealt with what may be regarded as the elementary principles of the production and use of electricity so that in addition to a knowledge of the fundamentals of his subject the student obtains a solid foundation upon which his future studies can be based.

The field covered comprises the electric circuit, electro-magnetism, direct current generators and motors and illumination with a chapter on elementary alternating current circuits. Since the study of electrical engineering necessarily includes work in the laboratory, suggestions for experimental work are given at the end of each chapter. These should prove of considerable assistance to the student and teachers might also find them of value as a source of additional experiments and as an indication of the best sequence of the work in the laboratory.

In dealing with the important subject of numerical examples, the authors have preferred to give original problems (with answers) rather than making use of previous examination papers. Much can be said in favour of this procedure but while, as they suggest, the student can obtain old examination papers, these do not contain the answers and nothing is so gratifying to a student as to find that he can work out actual examination questions correctly.—A.R.

Books Received

Dimensional Analysis. By H. E. Huntley, B.Sc., Ph.D. Pp. 158; index. Macdonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 20s.

Electric Motors and Control Gear. Edited by E. Molloy. Pp. 180; figs. and index. Geo. Newnes, Ltd., Tower House, Southampton Street, W.C.2. Price 17s. 6d.

The New Electrical Encyclopedia. General Editor, S. G. Blaxland Stubbs, O.B.E. Pp. 1,768; figs. 2,700; plates 113. The Waverley Book Co., Ltd., 96–97, Farringdon Street, London, E.C.4. Price £8 8s the set of 4 volumes and pocket book of tables, or purchasable at subscription rates.

Mercury Arc Convertors

Effect of Grid Control

By J. P. WOLFENDEN, M.SC., M.I.E.E.*

ESSENTIALLY, the effect of grid control in mercury arc convertors is to cause the arc to select a different period of the anode voltage cycle for current conduction. Thus, if the arc is regarded as a switch, connecting into circuit each anode in turn, then grid control alters the instant of closing of this "switch." Once current is flowing the "switch" cannot be opened until appropriate time has elapsed for the next anode to take over, or the instantaneous anode voltage becomes too low to maintain the arc. Moreóver grids are further limited in their action on the arc as they cannot advance the ignition point but only delay it relatively to the ignition point in an uncontrolled rectifier. The term "ignition angle" means the angle of arc delay measured from this point.

There are two conditions which must be satisfied for the arc to strike (assuming ionization present in the exciting circuit). First, the anode must be positive with respect to cathode, and secondly the corresponding grid must receive an instantaneous positive voltage to neutralize the effect of the negative grid bias.

The following cases will be considered and in all of them, even with inverted operation, the above conditions are fulfilled:—

(*a*) Small ignition angles, that is, angles up to the point beyond which the arc dies out on any anode before the next one strikes. This roughly is in the range 0–30 deg in a three-phase rectifier and 0–60 deg in a six-phase rectifier;

(*b*) Large ignition angles with non-inductive loads (covering the range of about 30–150 deg for a three-phase rectifier and 60–120 deg for six-phase;

(*c*) Large ignition angles with inductive loads;

(*d*) Inverted operation with d.c. supply voltage less than peak a.c. phase voltage;

(*e*) Inverted operation with d.c. supply voltage greater than peak a.c. voltage.

In (*a*), (*c*) and (*e*) there will be arc overlap—a short period when the current from one anode is diminishing whilst that from the next is building up. This period is a function of transformer reactance, number of phases and load current. The actual figures for the ranges of ignition angle in (*a*) and (*b*) are somewhat less than

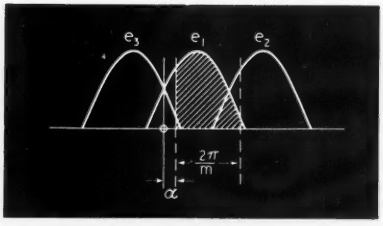


Fig. 1.—Calculation of average d.c. voltage at small ignition angles

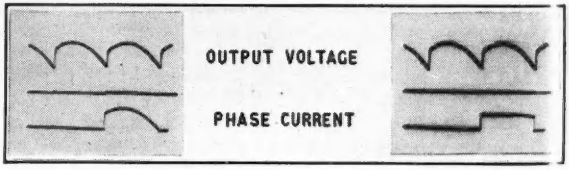


Fig. 2.—Three-phase rectifier operating at an ignition angle of 20 deg and (left) feeding non-inductive load; (right) feeding inductive load

* Head of Department of Electrical Engineering and Physics, Borough Polytechnic, London.

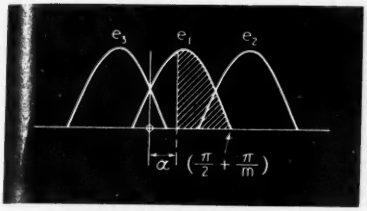
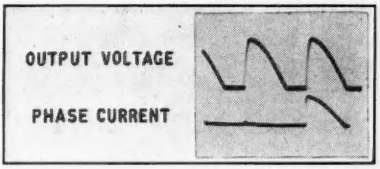


Fig. 3.—Calculation of average d.c. voltage at large ignition angles with non-inductive loads

Fig. 4.—Three-phase rectifier operating at an ignition angle of 60 deg and feeding a non-inductive load



those given above, in practice, on account of arc drop voltage.

In the calculation of average d.c. voltage at small ignition angles, taking point O (Fig. 1) as the datum from which the angles are measured, then if m = number of phases, α = ignition angle, E_p = r.m.s. phase voltage, the average height of the shaded area (E_D) will be $\frac{m}{2\pi}\int_{\alpha}^{\frac{2\pi}{m}+\alpha} e_1 \, d\,\theta$

and since

$$e_1 = \sqrt{2}E_p \cos(\theta - \frac{\pi}{m})$$

then

$$E_D = \frac{\sqrt{2}E_p m}{2\pi}\int_{\alpha}^{\frac{2\pi}{m}+\alpha} \cos(\theta - \frac{\pi}{m})\, d\,\theta$$

$$= \frac{\sqrt{2}E_p m}{2\pi}\left[\sin(\alpha + \frac{\pi}{m}) - \sin(\alpha - \frac{\pi}{m})\right]$$

$$= \left(\frac{\sqrt{2}E_p m}{\pi}\sin\frac{\pi}{m}\right)\cos\alpha$$

$= E_{DO}\cos\alpha$ where E_{DO} = average value of output voltage of an uncontrolled rectifier.

This is the well known cosine formula and it should be emphasized that it applies in general only over the limited range stated above. The actual value of d.c. output voltage across the load will be less than that given by the above principally on account of arc overlap. Other factors affecting the output voltage are transformer resistance and arc drop.

The type of load, i.e., inductive or non-inductive, fed by the rectifier will not alter the value of the output voltage either in magnitude or wave shape. The current, however, fed by each phase will become more rectangular for inductive loads. The oscillograms (Fig. 2) taken on a three-phase rectifier operating at an ignition angle of 20 deg illustrate these points.

In the case of large ignition angles with non-inductive loads the average value of voltage E_D again corresponds to the mean height of the shaded area (Fig. 3),

i.e., $E_D = \frac{m}{2\pi}\int_{\alpha}^{\frac{\pi}{2}+\frac{\pi}{m}} e_1 \, d\,\theta$

$$= \frac{\sqrt{2}E_p m}{2\pi}\int_{\alpha}^{\frac{\pi}{2}+\frac{\pi}{m}} \cos(\theta - \frac{\pi}{m})\, d\,\theta$$

$$= \frac{\sqrt{2}E_p m}{2\pi}\left[\sin\frac{\pi}{2} - \sin(\alpha - \frac{\pi}{m})\right]$$

$$= \frac{\sqrt{2}E_p m}{2\pi}\left[1 - \sin(\alpha - \frac{\pi}{m})\right]$$

This indicates that E_D would be zero when $\alpha - \frac{\pi}{m} = 90$ deg, i.e., $\alpha = 150$ deg for the three-phase case.

The ignition angle when this occurs is less than the equation suggests, in practice, due to arc drop voltage. Similarly the actual value of the d.c. output voltage will be less than that given by the above due to arc drop and transformer resistance. Accurate equations of output voltage are given in "Voltage Regulation of the Six-phase Fork-connected, Grid Controlled Mercury Arc Rectifier," Higham and Wolfenden, *Journal* I.E.E., Vol. 83, No. 500, August, 1938.

The oscillogram in Fig. 4 represents output voltage and phase current for $\alpha = 60$ deg in a three-phase rectifier feeding a pure resistance load. It shows the periods (horizontal portion in voltage wave) when

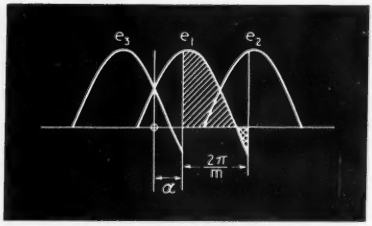


Fig. 5.—Calculation of average d.c. voltage at large ignition angles with inductive loads

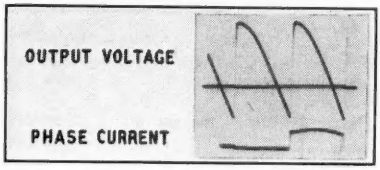
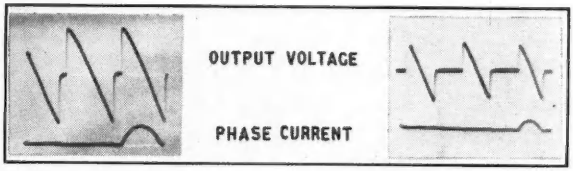
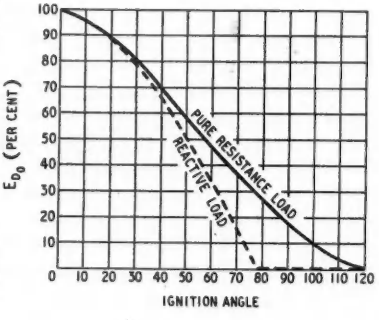


Fig. 6.—Three-phase rectifier operating at an ignition angle of 60 deg and feeding an inductive load

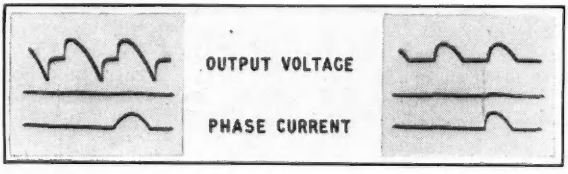


Above: **Fig. 7.—Three-phase rectifier operating at ignition angles of (left) 80 deg and (right) 100 deg and feeding inductive loads**



Right: **Fig. 8.—Typical grid controlled rectifier characteristics. The divergence between resistive and reactive load characteristic is explained in the text**

Below: **Fig. 9.—Three-phase rectifier operating at an ignition angle of 20 deg; (left) feeding a d.c. machine and (right) charging a battery**



the arc is extinguished on each anode before the next one strikes.

When considering large ignition angles with inductive load the average value of the output voltage is represented by the mean height of the shaded areas in Fig. 5. The value of this voltage will be less than in case (*b*) on account of the area below the x axis and will be given by the usual cosine law in case (*a*) providing there is no break in current conduction between one anode and the next. It is interesting to note that here current flows in each anode during a period when the instantaneous phase voltage is negative (represented by the double shaded area). This means that during this period inversion takes place, power returning to the a.c. supply. The wave shape of the phase current is roughly rectangular with conduction over a full period $\frac{2\pi}{m}$ as indicated in Fig. 6.

When the ignition angle is about 90 deg the shaded areas above and below the x axis are equal; the average value of the output voltage is zero and current flows over a period the mid-point of which occurs when the instantaneous voltage is passing through zero. This corresponds to zero power factor with equal amounts of rectification and inversion. If the load is insufficiently reactive, then an intermediate condition exists in which the a.c. anode voltage will be negative for a short period, followed by a period of arc extinction (Fig. 7). This condition will, of course, apply for all ignition angles greater than 90 deg however inductive the load may be.

D.c. motors offer inductive loads to a rectifier and batteries offer non-inductive

loads. The output voltage wave shapes could, therefore, be expected to be similar to the cases (*c*) and (*b*) above. This actually happens, as shown in Fig. 9. When working at small ignition angles there will generally be a period when the arc is extinguished on each anode due to the phase e.m.f. falling below the back e.m.f. of the d.c. machine or the battery, grid control having no effect over this range.

The oscillograms, however, show a longer period of current conduction for identical conditions when feeding a machine. This is again due to the inductance of the load circuit raising the anode above the cathode potential and thus maintaining the arc for a longer period.

Satisfactory speed control is obtained on d.c. machines by this method (Fig. 10). The characteristic of a machine can be controlled or altered as desired, by providing automatic phase shift in the grid circuits for changing load conditions.

Considering inversion with a d.c. supply voltage less than the peak a.c. phase voltage, if the grid becomes positive at a point when the phase voltage e_1 is negative (α_1 in Fig. 12) then with a d.c. supply connected as shown there will be a resultant voltage y available between anode and cathode to produce an arc. Current will flow still in the same direction in the circuit as for a rectifier but since e_1 is reversed, power is reversed. It is only in this sense that a mercury convertor can be regarded as working from d.c. to a.c.; that is, the a.c. supply must first be available for supplying the grid and starting circuits in addition to exciting the main transformer. The arc is then caused to strike when the phase voltage is negative, thus causing power to pass from d.c. to a.c. sides.

In the above case where the instantaneous phase voltage rises to a greater value than the d.c. supply the period of conduction will correspond to x in the sketch (neglecting arc drop) since at point p there is no longer any resultant voltage between anode and cathode and the arc here will die out.

If α_1 is increased in Fig. 12 then the period of conduction x will be reduced and the magnitude of the current also will be reduced. If α_1 is increased to α_p there will be no arc and therefore no power transfer. Alternatively, if α_1 is reduced then the current will be increased but will be flowing when the a.c. voltage is less negative. This

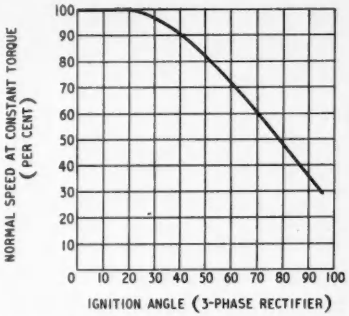


Fig. 10.—Typical shunt motor fed from a grid-controlled rectifier

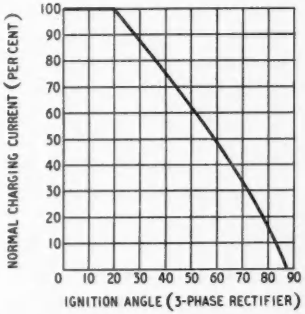


Fig. 11.—Battery charging from a grid-controlled rectifier

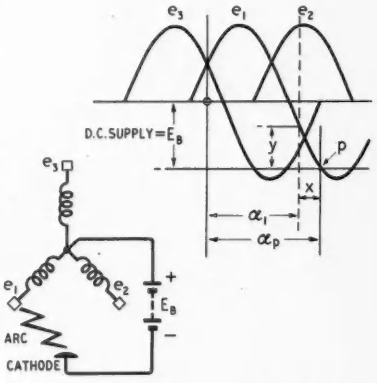


Fig. 12.—Inversion with a d.c. supply voltage less than the peak a.c. phase voltage

means that the power factor will fall. If α_1 is reduced sufficiently (approximately to 90 deg) then p.f. becomes zero and again there is no average power transfer. This case has been considered above in (*c*) with $\alpha = 90$ deg. There will, therefore, be some optimum value of ignition angle for maximum power transfer, depending principally on the magnitude of the d.c. supply E_B.

Finally, if the d.c. supply voltage is greater than peak a.c. phase voltage (Fig. 13) the arc will strike or remain ignited to whichever anode has the highest potential (relative to cathode). If the grid of anode 1 is delayed to α_1 then there is again a voltage y available to initiate the arc on each anode in turn. The period of conduction will be $\frac{2\pi}{m}$ and at the end of this period commutation to anode 2 will take place naturally. This is because there is a lower voltage (y_1) between anode 1 and cathode than the voltage (y_2) between anode 2 and cathode. The arc will, therefore, transfer to anode 2 at this instant, since grid 2 will also have become positive, fulfilling the second of the conditions for establishment of the arc. The magnitude of power transfer depends upon the d.c. voltage E_B and is limited by the current carrying capacity of the arc circuit. As the ignition angle α_1 is increased, power factor will increase, limited by the range of stable working.

If the ignition angle α_1 is increased to a value such as α_1 in Fig. 14, then at the end of the conduction period $\frac{2\pi}{m}$, there is no inducement for the arc to leave anode 1 and transfer to anode 2. This is because the anode-cathode voltage (y_2) for the next anode is less than that (y_1) to which the arc is established. The phase voltage e_1 becomes increasingly positive and with E_B assisting round the transformer circuit (see Fig. 12) short circuit conditions exist. With no arc overlap the ignition angle at which instability sets in would be 180 deg. The criterion, however, is that the arc on anode 1 must be extinguished before the voltage of anode 1 rises above that of anode 2, and so on for anodes 2 and 3, etc. Hence, due to the reactance of the transformer circuit the actual angle in practice is somewhat less than 180 deg for the limit of stable working. This means

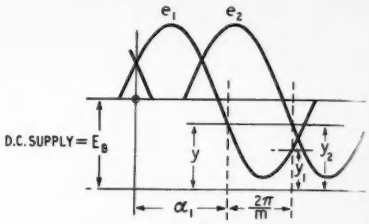


Fig. 13.—Stable operating range when inverted with a d.c. supply voltage greater than the peak a.c. voltage

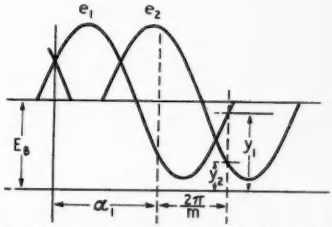


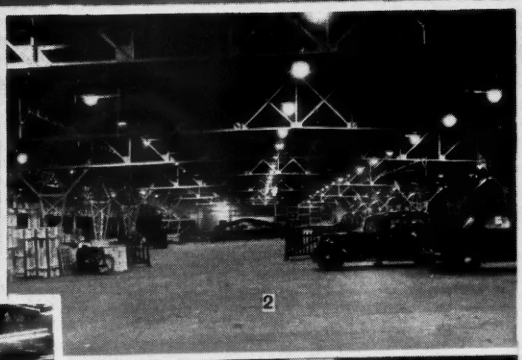
Fig. 14.—Unstable operating range when inverted with a d.c. supply voltage greater than the peak a.c. voltage

that the power factor cannot be unity since the ignition angle to give this would be in the unstable range.

Special precautions must also be taken to ensure that when shutting down an invertor the d.c. supply is interrupted before the a.c.; otherwise there is no balancing a.c. phase voltage and an arc might be maintained from the d.c. side with current limited only by the arc and the small resistance of one phase of the transformer secondary.

Copper and Alloys Data

THE tabulated data on copper and its alloys contained in the latest issue of publication No. 36 of the Copper Development Association have not only been revised to take into account the new British Standards that have appeared since the last edition of 1948, but additional copper-base alloys have also been included. It has naturally not been possible to particularize every alloy now in use, especially the proprietary materials, but the most important commercially have been included. This 28-page booklet is available from the C.D.A., Kendals Hall, Radlett, Herts.



Some Recent Lighting Installations

(1)—Indirect fluorescent lighting at the Bradford showrooms of J. Cawthra & Co., Ltd., textile manufacturers (British Thomson-Houston Co., Ltd.). (2)—Dispersive reflectors in the shed of the Docks and Inland Waterways Executive, Southern Region, Southampton Docks (Simplex Electric Co., Ltd.). (3)—Fluorescent lighting at the Alperton premises of Dagenham Motors, Ltd. (Siemens Electric Lamps & Supplies, Ltd.). (4)—Lighting at the Leicester shoe factory of T. Roberts & Sons, Ltd. (Micramatic, Ltd.). (5)—Tungsten fittings in matt reflectors at the American Officers' Club, South Ruislip (General Electric Co., Ltd.). (6)—Lighting at the Keystone Knitting Mills, Elstree (Metropolitan-Vickers Electrical Co., Ltd.). (7)—Car showroom of Vincents, Yeovil, using "Ashford" fluorescent lighting fittings (Crompton Parkinson, Ltd.)

Engineering in Europe

Survey of Current Literature

A BRIEF summary of the electrical, thermal, mechanical and chemical influences on contact performance prefaces enumeration of the metal compositions (alloys and products of powder metallurgy) on which the interest of designers now centres. Copper and its alloys, silver and its alloys, tungsten and molybdenum, all have valuable contributions to make but their main merits are as components of composite systems which, when appropriately balanced, will help to solve problems of contact design for widely differing purposes.

Surface oxidation is the great enemy of base-metal contacts while sputtering is the unpleasant habit of silver contacts, but small admixtures of other metals help to suppress these unfavourable characteristics; palladium, for instance, makes silver resistant to sulphur. Noble metals are used for plating base-metal contacts, the best process being "cladding"; bimetal contacts answer well in heavy-current work.—"Materials for Electric Contacts," H. Gagel and H. Dittler, *E.T.Z.*, Vol. 73, No. 9, pp. 292–294, 1st May, 1952, in German.

Network Diagrams

The representation is based on an equivalent π line and the charts are plotted in a co-ordinate system with a horizontal axis of reactive and vertical axis of active quantities in clockwise sense of rotation. The main quantities used in the plot are the shunt and series admittances ($\dot{Y}_q$, $\dot{Y}_\pi$) of the equivalent π-circuit, related with the propagation factor $\dot{g}$ and characteristic admittance $\dot{Y}_w$ of the line by the expressions $\dot{Y}_q = \dot{Y}_w \tanh \dot{g}/2$ and $\dot{Y}_\pi = \dot{Y}_w/\sinh \dot{g}$. The admittance diagram of the voltage ratio $\dot{U}_s/U_r$ plotted with these quantities and the load admittance $\dot{Y}_l$ becomes for the usual values of the latter too inaccurate for graphical calculation. The author therefore develops a geometrical method of selecting appropriate scale magnifications for the important quantities combined with a construction method for large circles (point by point) without using their centres (and, therefore, compasses) so that any desired accuracy of the diagrams may be obtained. It leads to a polar type meshwork, a pattern of circular arcs and radial lines, which is easy to gradate and offers all the accuracy and convenience required for this type of calculation.—"Network Diagrams for the Rigorous Calculation of Long Transmission Lines," H. Kafka, *Archiv. für Elektrotechnik*, Vol. 40, No. 5, pp. 304–315, 1952, in German.

Surge Phenomena

In this short symposium J. Neuve-Eglise deals first with the self-protection of substations against atmospheric surges, particularly with the influence of the busbar arrangement on the capacity for self-protection of the substation, and with the effects of the steepness of the impinging wave-front; the same author analyses in a second paper oscillograms of atmospheric surges transmitted through a step-up transformer of a power station and discusses possible events with reference to the appropriate equivalent circuits.

P. G. Laurent contributes an analysis of a special case of surge transmission through a 220/11 kV transformer to an alternator separated by an armoured cable line of 250 m length. J. Neuve-Eglise then discusses the distribution of a voltage surge along a hydro-alternator winding consisting of sections of several turns, and in another paper deals with the characteristics on which depends the protection level of surge divertors at the neutral point of transformers. The last paper, by G. Rivet, briefly considers the capacitance of impulse generators needed for testing power transformers.—"Some Actual Problems Connected with Surge Phenomena," P. G. Laurent, J. Neuve-Eglise, G. Rivet, *Bulletin Soc. Franc. des Electriciens*, 7th Series, Vol. 2, pp. 210–223, April, 1952, in French.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

VIEWS on the NEWS

By REFLECTOR

GRAIN drying is a subject of importance to farmers at this time of year. A Ministry of Agriculture publication on the subject states that the estimated cost of a platform grain dryer installation is about £400 upwards. This statement is challenged in the *Farmer & Stock-Breeder* by Mr. C. A. Cameron Brown, agricultural electrification adviser to the B.E.A. He says it may be deduced that the reference is to a dryer of the 40–50 cwt size but an all-electric installation of this size has been provided for £305. He also quotes an "extreme example" of a 48 cwt dryer which cost only £157, but this had a reduced extraction rate. The electricity industry has made efforts during the past three years to produce platform drying equipment at a lower cost than alternative methods and now a 20 cwt dryer can be installed for as little as £112.

* * *

A *Manchester Guardian* correspondent refers to a Tass Agency report which says that Soviet technicians have again proved their superiority over those of other nations by installing a switch in a roadway so that traffic approaching a crossing can change the lights to green. Some readers may think that they have seen something of the sort in this country, but the Russian switch can distinguish an ambulance or a fire engine from other vehicles and can give them instant priority.

* * *

Maybe there is something in this. By coincidence I have come across a report in the *Yorkshire Post* of a similar device. A Doncaster radio engineer is said to have designed a system by which fire engines can be given a clear run. An "electronic ear" would be set up about a hundred yards from traffic lights and connected to a landline. On receiving the sound of a fire engine's siren it would automatically switch all the lights to red. At the same time a visual signal would warn other road users of the fire engine's approach. The inventor thinks that his device could be adapted to operate also for ambulances and police cars.

* * *

An unusual case was heard at the Glamorgan Assizes, Swansea, last week. A Mrs. Jewell, who was employed by the Glamorgan County Council as a "home help," sued that body for damages in respect of an electric shock which she sustained in the course of her duties. She also claimed against the estate of the woman (since deceased) in whose house she was working and against that lady's son. Mrs. Jewell said that while plugging in an electric kettle she was badly burned and lost the use of her left hand. She contended that the County Council should have seen that the house was safe to work in and have made periodical inspections. Mr. Justice Croom Johnson held that the Council had no obligation to make sure that a house was safe to work in. He also held that the deceased householder's son had no duty in connection with the electrical installation and he dismissed the claims. Unfortunate as the result was for the claimant, it would certainly have opened up illimitable prospects if the Council had been held blameworthy.

* * *

London has succeeded in getting rid of its electric trams which many people (wrongly of course) considered to be anachronistic and yet it still tolerates a great deal of gas lighting. According to a correspondent of *The Times*, in central London alone there are 50,000 gas lamps; at least 100 miles of the streets in the City of Westminster are gas-lit. Much of the lighting is of the high-pressure variety, but the rest of it imparts after dusk the squalid Victorian semi-gloom which gives an authentic background to many British films in which too many people are up to no good. I feel sure that conversion to electricity would improve standards all round.

Ulster Programme Revised

Reduced Rural Construction

MANY rural communities in Northern Ireland expecting soon to obtain an electricity supply will now have to wait for some years. This is made clear in the Electricity Board's annual report for 1951 submitted to the Minister of Commerce. Shortage of materials and the general financial stringency are stated to have made it necessary for the rural construction programme to be substantially revised and the amount to be spent greatly curtailed. Mr. Lendrick McMaster, the Board's secretary, points out that the altered circumstances will inevitably have repercussions throughout the Board's area of supply and will lead to a diminution of the number of workers employed.

One of the chief difficulties in financing rural development has been the smallness of the revenue in relation to capital expenditure. Schemes approved by the Board during the year, designed to afford supplies to 1,794 farms, 3,158 rural dwellings and 317 other potential consumers, including churches, schools and industrial establishments, are estimated to cost £1,032,176 and the annual revenue expected would give a return of only 8 per cent, which is, of course, quite inadequate to meet the capital charges alone. Increased use of electricity for all the many purposes for which it provides a labour-saving and economic service would help to close the gap. Development work actually carried out in rural areas last year involved a capital expenditure of £811,435.

System extensions completed last year aggregated approximately 348 miles of high-voltage lines (making 2,497 miles in all) and 250 miles of low voltage mains (total, 1,503 miles). Two 33 kV switching stations—at Ballymena and Magherafelt—were completed. At the Carrickfergus main substation construction work proceeded in connection with the installation of circuit breakers to provide sectionalizing and protection facilities on the ring feeder Ballylumford–Carrickfergus–Ballyclare and the 33/11 kV transformers for the Carrickfergus 11 kV system. At Ballyclare main substation complete reconstruction was undertaken to provide improved operational facilities. Work also began on a new 33 kV switching station at Omagh. A second 37,500 kVA 33/110 kV step-up on-load tap change transformer was put into service for the Ballylumford–Ballymena line.

In 1950 the Ministry of Commerce asked the Board to carry out, on its behalf, investigations into the hydro-electric resources of the River Bann at Carnroe and the River Mourne near Sion Mills. Messrs. Kennedy & Donkin and Sir William Halcrow & Partners were instructed to submit reports which were duly forwarded to the Ministry. The Board has been advised that the Ministry is considering the preparation of schemes in respect of both projects and has been asked for its observations.

A fourth set was commissioned at Ballylumford power station, raising the capacity to 124,500 kW. The Board sold 291·2 million kWh, compared with 251·7 million in 1950, an increase of 15·7 per cent. Consumers at the end of the year numbered 109,506, an addition of 8,621.

Gross revenue amounted to £1,944,449 (against £1,668,583), working expenses were £1,429,573 (£1,349,762), and capital charges together with £100,000 for taxation, £513,057, leaving a net surplus of £1,819. At 31st December last the Board's capital expenditure totalled £13,623,204, a sum of £1,793,353 having been spent during the year, including £161,436 for the further extension of the Ballylumford station and associated transmission system and £558,408 on l.v. distribution.

The average price received per kWh sold was 1·54d against 1·53d in 1950. Charges remained unaltered throughout the year, but to meet higher costs revised tariffs have since been brought into operation.

Insulation "School"

A FIVE-DAY Vacation School on the insulation of electrical equipment is to be held in the Electrical Engineering Department, Imperial College of Science and Technology, London University, from 15th to 19th September. The object is to consider the factors which are limiting insulation design in the main classes of equipment and the general principles which should govern the approach to the solution of outstanding problems.

The outline programme is as follows:—"History of Electrical Insulation Development," Professor Willis Jackson; "Permittivity and Dielectric Loss, with particular reference to the effects on them of Temperature, Humidity, Ageing and Deterioration," Dr. L. Hartshorn; "Dielectric Breakdown," Dr. S. Whitehead; "The Structural Basis of Physical and Mechanical Properties," Mr. C. G. Garton; "Classification and Review of Insulating Materials," Mr. R. Snadow; "Communication Components," Mr. I. M. Ross; "Power Cables and Capacitors," Dr. L. G. Brazier and Dr. R. S. Vincent; "Electrical Machines," Mr. E. Jones; "Transformers," Mr. D. McDonald; "Switchgear," Mr. P. G. Ashley; and "Insulation Testing in the Laboratory, Factory and Field," Dr. J. S. Forrest.

PERSONAL and SOCIAL

News of Men and Women of the Industry

FOR risking death to save a fitter at Margam steel works, **Mr. E. G. Walters,** a fuel technician, has been awarded the George Medal. The fitter was working on a gas main 35ft above ground when his neck came into contact with a bare electric wire and he received a shock. Mr. Walters, without thought for his own safety, immediately went to the man's aid and in spite of receiving severe shocks clasped him firmly so that he should not fall to the road below. For their help in the rescue **Mr. F. Childs,** an electrician, and **Mr. D. Thomas,** fitter's mate, receive the Queen's commendation.

Mr. G. W. Mitchell, A.M.I.E.E., until recently district engineer, No. 1 (Hull) District, Yorkshire Electricity Board, has been appointed engineer of the No. 6 (Hull) Sub-Area in succession to Mr. H. Mallalieu, M.I.E.E., who retired from this position on 6th May.

At St. George's Hill Golf Club, Weybridge, on 24th July, about fifty competitors took part in the **Electrical Industries Benevolent Association London Area Golf Championship.** Although the scoring was not as low as had been anticipated an excellent day was had by all. During the evening Sir Henry Self, deputy chairman of the British Electricity Authority, presented the prizes to successful competitors. These will now represent the London Area in the National Championships to be played at Worthing in October. Members of the London Area Golf Committee present included Messrs. E. Young, E. A Mills, I. Williams and C. Royce.

Mr. L. de Wynter has been appointed manager of the Ipswich branch of British Insulated Callender's Cables, Ltd., as from 1st August, in succession to **Mr. A. R. Driessen** who has been appointed commercial manager of the Indian Cable Co., Ltd. Mr. de Wynter joined the former British Insulated Cables, Ltd., in 1932 and subsequently gained wide experience of the company's products in the various departments of the Prescot and Helsby Works. He was transferred to the outside staff of the Birmingham branch in 1939 and became the senior capacitor sales engineer.

Mr. L. de Wynter

Sir Ronald W. Matthews, chairman of the Brush Electrical Engineering Co., Ltd., and chairman of the former London & North Eastern Railway, is a member of the committee appointed by the Minister of Transport to inquire into the licensing of bus services.

At the E.I.B.A. London Area golf meeting (left to right): Sir Henry Self, Mr. Ivor Williams (G.E.C.), Mr. E. Young (chairman, Young & Wildsmith) and Mr. W. J. Bird (G.E.C.)

I.T.D., Ltd., in association with Austin Crompton Parkinson Electric Vehicles, Ltd., announce the appointment of **Mr. Allan C. Cooper,** M.S.M.A., as general manager. Mr. Cooper joined I.T.D., Ltd., some five years ago in charge of the design and development department, and two years later was appointed United Kingdom Division manager, controlling all home sales activities. At the same time he became technical adviser in connection with overseas sales. In 1951 he was appointed acting sales manager. Mr. Cooper, who is 36 years of age, started his career with Hoover, Ltd. During the 1939-45 war he held a commission

in the R.A.O.C. and served as a major until the end of hostilities.

Mr. T. R. Monkhouse has been appointed manager of the British Mechanical Productions Bristol factory. British Mechanical Productions, Ltd., and the General Accessories Co., Ltd., were amalgamated with the Edison Swan Electric Co., Ltd., in September, 1951, and since 1st January all sales have been dealt with by Ediswan. Mr. Monkhouse served in various capacities with the Metropolitan-Vickers Electrical Co., Ltd., from 1921 to 1943, and was closely associated with the original development of radar from 1938 onwards. He was awarded the British Empire Medal in 1943. From 1944 he was associated with Wm. Gardner & Sons, Gloucester, the Brierley Engineering Co., and the Alite Machine Co.

Mr. T. R. Monkhouse

Mr. D. J. Dykes, of Maldon, has been appointed representative of Ekco-Ensign Electric, Ltd., for South-East Essex. He replaces Mr. J. Dunham, who recently left the company's service.

Mr. G. H. Dunmore, B.Sc., has been appointed lecturer in electrical engineering at Constantine Technical College, Middlesbrough, as from 1st January next.

OBITUARY

Mr. J. B. Kramer.—We are informed by the General Electric Co., Ltd., that Mr. John Baptist Kramer, M.I.E.E., died at Kingussie, Inverness-shire, on 28th July in his seventy-eighth year. Mr. Kramer was a scientist and inventor and a pioneer in the field of magnetism as applied to industry. He founded the Witton-Kramer Electric Tool and Hoist Works, of which he was general manager, in 1909 and worked in collaboration with the G.E.C. until his retirement thirty years later. Mr. Kramer was best known for his work on the development of electric cranes in this country and the use of photo-electric cells as detecting devices. In both world wars he gave valuable service to the country. During the last war, in addition to working on anti-submarine devices, he co-operated with the Royal Navy in producing a smoke detector which gave warning to a ship when its own smoke became visible. Another invention was a safety device for use when unexploded bombs were being dealt with. Mr. Kramer gave many lectures and demonstrations of his work in all parts of the country and he was author of a number of scientific publications, one of the most notable being "Radiations from Slow Radium," published in 1921. Mrs. Kramer is a daughter of the late Sir Oliver Lodge.

Alderman H. J. Galliers, who died at Brighton on 29th July at the age of seventy-two, was the proprietor of the Brighton electrical contracting concern bearing his name, which he founded about fifty-three years ago, and was for many years active in the affairs of the local branch of the Electrical Contractors' Association. Mr. Galliers was educated at the Brighton Technical College and was an alderman of Brighton for 25 years, having been Mayor in 1928-29. He was also chairman of the Brighton and Sussex Building Society.

Mr. Richard Wilson, area chief electrical engineer (Edwinstowe), National Coal Board, died recently while on holiday. He was sixty-seven. Mr. Wilson was apprenticed with Howard & Bulloughs, Accrington, and subsequently held positions with the Accrington, Worksop and Mansfield electricity undertakings, becoming charge engineer. In 1913 he joined the Stanton Ironworks Co. at Pleasley Colliery as chief electrician, and in 1920 was appointed chief electrical engineer for the Stanton group of collieries. On the formation of the N.C.B. he was appointed No. 2 Area chief electrical engineer, East Midland Division, later being transferred to No. 3 Area (Edwinstowe). He was a past president of the Midland branch of the Institution of Mining Electrical and Mechanical Engineers.

Mr. K. F. Kingwell.—The death occurred on 31st July of Mr. Kenneth Francis Kingwell, who had retired from the British Thomson-Houston Co., Ltd., Rugby, in October, 1945, after thirty-six years' service. He was in his seventy-second year. Mr. Kingwell joined the B.T.H. Co. as a junior draughtsman in 1903, leaving in 1913 to take up an appointment as works manager of Sandicroft's Foundry, Chester. He was severely wounded in the 1914-1918 war. Returning to the B.T.H. Co. in 1919, he was appointed apprentice supervisor, and later superintendent of the Personnel Department. In 1941 he became superintendent of the Small Gear Assembly Department, which position he held at the time of his retirement.

Mr. W. Shearer.—A memorial service to the late Mr. William Shearer, chairman of Balfour Beatty & Co. and other companies, was held at St. Martin-in-the-Fields on 30th July. It was conducted by the Rev. L. M. Charles-Edwards and Sir Robert Renwick, Bart., gave an address. The electrical industry was represented by a number of prominent members.

Mr. Arthur Collins, chairman of Reliance-Clifton Cables and Industrial Products, Ltd., died on 26th July at Bromley, Kent, at the age of seventy two.

Mr. E. Ellwood.—The death occurred on 31st July of Mr. Ernest Ellwood, of the Major Electric Co.

Constitution of the B.E.A.

Announcement by Minister

MEMBERS of the British Electricity Authority were appointed for a period of five years dating from 15th August, 1947, which means that the present appointments terminate on 14th August. In the House of Commons last week the Minister of Fuel and Power made an announcement on the subject.

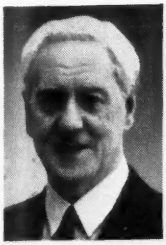
Mr. Geoffrey Lloyd said that he had reappointed Lord Citrine as chairman of the Authority and Sir John Hacking and Sir Henry Self as deputy chairmen. He was also reappointing two other existing (part-time) members of the Authority—Dame Caroline Haslett and Lieut.-Col. E. H. E. Woodward.

In accordance with the provisions of the Electricity Act, 1947, four chairmen of Electricity Boards (at present Messrs. H. H. Mullens, H. Nimmo, S. F. Steward and C. T. Melling), and also the chairman of the North of Scotland Hydro-Electric Board, the Rt. Hon. Thomas Johnston, would continue to be members of the Authority.

Two members of the Authority, Sir William Walker (a part-time member) and Mr. E. W. Bussey, would retire. Sir William Walker was not being reappointed on account of his age. Mr. Bussey had tendered his resignation on the ground that following a serious operation he wished service of a less onerous character. Mr. Lloyd expressed his appreciation of the valuable services which these two gentlemen had rendered.

He had appointed Councillor J. Sullivan, at present a member of the South West of Scotland Electricity Board, as a member of the Authority and he proposed to fill the other vacancy shortly.

Later it was announced by the Ministry



Lord Citrine

Sir Henry Self

Sir John Hacking

Lt.-Col. E. H. E. Woodward

Dame Caroline Haslett

Mr. J. Sullivan

Mr. E. W. Bussey

Sir William Walker

that all the reappointments and new appointments were for three years except in the case of Lieut.-Col. Woodward, whose reappointment was for two years.

The new member, Councillor J. Sullivan, is a member of the Transport and General Workers' Union, and has been a member of the South West Scotland Electricity Board since its inception. He is a member of the Scottish Committee of the White Fish Authority. He will cease to be a member of the South West Scotland Electricity Board.

Lord Citrine, K.B.E., was general secretary of the Trades Union Congress from 1926 to 1946 and a member of the National Coal Board from 1946 to 1947. Sir Henry Self, K.C.B., K.C.M.G., K.B.E., was Permanent Secretary of the Ministry of Production in 1942–43; deputy chairman, British Supply Council, Washington, 1945; and Permanent Secretary, Ministry of Civil Aviation, 1946–47. Sir John Hacking, M.I.E.E., was chief engineer of the former Central Electricity Board. Dame Caroline Haslett, D.B.E., Comp.I.E.E., is adviser to the Ministry of Labour on Women's Training, and director and secretary of the Electrical Association for Women. Lieut.-Col. E. H. E. Woodward, M.C., T.D., M.I.E.E., was a director and general manager of the North Eastern Electric Supply Co., Ltd. The Rt. Hon. Thomas Johnston was Secretary of State for Scotland from 1941 to 1945.

Mr. Mullens is chairman of the North Eastern Electricity Board, Mr. Nimmo of the Southern Board, Mr. Steward of the South Western Board and Mr. Melling of the Eastern Board.

The salary of the chairman of the Authority is £8,500 per annum and the deputy-chairmen each receive £5,000. The other full-time member, Mr. Bussey, receives £3,500 and the part-time members £1,000 each. The Area Board representatives are paid as chairmen of Area Boards—£4,000 per annum. The B.E.A. as a whole receives an annual allowance (for expenses) of £2,500.

STANDARD SPECIFICATIONS

AS an adjunct to the recently published B.S. 1853 for tubular fluorescent lamps, Class MCF/U, there has now been issued B.S. 1875 for bi-pin caps and holders for those lamps. It covers both G 13/23 and G 13/35 types, dimensions being in accord with I.E.C. recommendations. Sections are included on general requirements, tests, marking and gauges while an appendix contains recommendations for fixing the holders.

B.S. 1872 for electroplated coatings of tin on fabricated articles made of iron, steel and copper and its alloys covers five classes of coating according to the use to which the coating is to be put. Details of sampling, finish, solderability, thickness, adhesion, heat treatment and test are included.

Copies of these specifications, each price 2s 6d post free, are obtainable from the British Standards Institution, 24, Victoria Street, London, S.W.1.

X-ray Films and Screens

In the revised edition of B.S. 1443 for X-ray film and intensifying screens, medical and industrial, there are two additional sizes: 11 by 14in and 15 by 40 cm. Minor adjustments have been made to tolerances on the cutting sizes and in cases in which nominal sizes are the same as those of photographic sheet film (B.S. 1772) both cutting dimensions and tolerances have been made to accord. The method of making packaged films and screens is indicated. Separate specifications are to be issued for casettes and for dental and crystallographic films. The revised document is obtainable from the British Standards Institution, 2s post free.

I.E.C. Specification for Tungsten Lamps

The International Electrotechnical Commission has published the first edition of an international specification for tungsten filament lamps for general service. Like all other I.E.C. specifications this one expresses as nearly as possible an international consensus of opinion regarding a specification for lamps and is intended to serve as a model on which various countries can base their own international standards.

Copies of this I.E.C. publication (No. 64), price 10s 4d post free, are obtainable from the British Standards Institution, which has issued a list (P.D.1460) of all the available publications of the I.E.C. and of the International Commission on Rules for the Approval of Electrical Equipment (C.E.E.) which are obtainable from the B.S.I.

PARLIAMENTARY NEWS

From Our Special Reporter

IN the House of Commons last week the Secretary of State for Scotland (Mr. Stuart) told Mr. Nabarro that he was informed by the North of Scotland Hydro-Electric Board that the total installed capacity of its hydro-electric works at 30th June was 391,000 kW, with an average annual load factor of 27·4 per cent.

The aggregate capital expenditure of the Board in respect of each calendar year since 1943 was as follows:—1943–1944, £136,846; 1945, £195,954; 1946, £1,796,204; 1947, £5,040,666; 1948, £12,401,739; 1949, £13,410,673; 1950, £12,213,551; 1951, £11,409,786. The estimated expenditure during 1952 was £14,000,000. In addition, a sum of £8,772,346 was charged in the Board's accounts for 1950 representing the net values of the assets of company and municipal undertakings which vested in the Board as at 1st April, 1948.

The Board informed him that the capital expenditure to 30th June, 1952, on completed hydro-electric schemes (including a sum equivalent to the cost of the pre-war Rannoch and Tummel schemes) was £35,852,000; that uncompleted hydro-electric schemes on which work had begun were estimated to cost £39,500,000; and that hydro-electric schemes authorized but not yet begun were estimated to cost £800,000. As regarded transmission and distribution, the expenditure in the whole of the Board's area—which was not entirely supplied from hydro-electric sources—amounted at 30th June to £5,902,000 and £16,188,000 respectively.

Lancashire Tariffs

Mr. Anthony Greenwood asked the President of the Board of Trade whether he was aware that the textile industry in the Rossendale Valley had been adversely affected by the serious increase in the cost of electricity which had followed upon the introduction of tariff "M" in April, and what plans he had for alleviating the situation.

Mr. Peter Thorneycroft said he was aware of the increase in electricity charges affecting the textile industry in the Rossendale Valley and elsewhere. He understood that discussions were in progress between the North Western Electricity Board and representatives of the textile industries concerned.

Cost of Wenvoe Station

The Assistant Postmaster General, Mr. Gammans, informed Mr. David Jones and Mr. Grey that the estimated total cost of the television station at Wenvoe was £320,000; it would be contrary to the policy of giving the B.B.C. control of details of capital expenditure for him to ask the Corporation to subdivide this figure to show the cost of the buildings, mast and equipment separately.

Commander Donaldson asked the Assistant Postmaster General if he was aware of the poor standard of television reception in the Scottish borders; and if he would state when the Kirk o'Shotts high-power transmitter would be put into operation.

Mr. Gammans said that the B.B.C. informed him that even with a high-power transmitter it would not be possible to guarantee reliable reception of television programmes throughout the Scottish borders. The high-power transmitter would, however, give a better service than at present and the Corporation expected shortly to be able to fix a date for bringing it into operation.

Commercial Television

Mr. Mikardo asked when it would be possible to consider applications for licences to bodies or persons other than the B.B.C. to broadcast television programmes for reception in the home, and licences for the development of television for public showing; and which of these two groups of projects would receive the higher priority.

Mr. Gammans said it was too early to make any statement on these matters.

Mr. Hayman asked the Assistant Postmaster General whether he would request the B.B.C. to secure a site for the proposed television transmitter for South Devon and Cornwall which would provide satisfactory reception for the whole area, instead of a site on North Hesary Tor which would isolate most of West Cornwall from effective reception.

Mr. Gammans said that the B.B.C. informed him that it would not be possible to find a site from which satisfactory service could be given over the whole of Cornwall as well as those parts of Devon outside the effective range of Wenvoe.

Miss Ward asked the Assistant Postmaster General if, in view of the fact that the capital expenditure involved in co-operating over television with France was more than the proposed expenditure to give television to the North-East coast, he would now consider providing this service for this part of Great Britain.

Mr. Gammans said the B.B.C. told him that

there was no capital cost in the normal sense of the word since the equipment used was not specially bought or manufactured but formed part of the standard equipment for outside transmissions.

Overseas Telecommunications

Mr. Deedes was informed by Mr. Gammans that the Postmaster General recently appointed a working party under the chairmanship of Sir Stanley Angwin to review the present organization of the overseas telecommunications services and, after consideration of its report, he had decided to set up a Post Office External Telecommunications Executive charged with the direct administrative and operational control of the overseas telegraph and telephone services. The main objective was to provide a clear chain of responsibility and the details were now being worked out.

V.H.F. Broadcasting

Commander Donaldson asked the Assistant Postmaster General if, in view of the poor reception of the present radio services in the Scottish borders, he would press for the employment of very high frequency; and if he would give an indication as to when such wavelengths would come into use.

Mr. Gammans said that in view of the national economic situation and the consequent restriction of capital investment, he regretted that he could not say when the B.B.C. was likely to be able to introduce v.h.f. broadcasting. The technical problems involved, including the type of modulation to be adopted, would be considered by the committee which was also to advise on television.

Heavy Electrical Plant Council

Mr. Edward Wakefield asked the Minister of Supply what consultations he had held with the heavy electrical plant industry with a view to increasing its contribution to the export drive.

Mr. Sandys said he had constituted a Heavy Electrical Plant Consultative Council, under his chairmanship, to provide a means of regular consultation between the Government and the heavy electrical plant industry. This replaced the Heavy Electrical Plant Committee whose meetings were discontinued in July, 1950. The members of the Council were:—

Mr. E. H. Ball, Mr. I. R. Cox, Sir Claude Gibb, Sir George Nelson, Sir Harry Railing and Mr. B. H. Leeson, representing electrical plant manufacturers; Messrs. C. K. F. Hague, F. G. Mitchell, F. G. Penny, E. W. Thompson, W. E. Young and K. J. McKillop, representing water tube boiler manufacturers; Sir John Hacking, Mr. V. A. Pask and Sir Henry Self, representing the British Electricity Authority; and Messrs. F. Foulkes and E. J. Hill, representing the Confederation of Shipbuilding and Engineering Unions.

Representatives of the North of Scotland Hydro-Electric Board and Government Departments attended meetings as appropriate.

Economic Policy

Mr. Butler, the Chancellor of the Exchequer, in his review of economic and financial policy, emphasized the need to increase exports. In allocating raw materials the Government would continue to give preference to exports and particularly those to the dollar area. It would moderate the exchange control over credit terms, and widen the facilities provided under the Export Credits Guarantee Act so as to help to make export offers competitive. He again stressed how important it was for the commercial banks to continue to give priority to exports in the administration of credit.

At home, industrial activity had been stable since the Budget. In fact, in the first two months of the financial year output was, if anything, slightly lower than in the corresponding months of 1951. In some industries things were better, especially in coal. The steel outlook, too, was more promising; more supplies would be available this year than last, and since it had been the shortage of steel which had held back production in many industries, he was hopeful that the increased supplies would lead to an expansion of output in the engineering trades.

Royal Assent

The Royal Assent was given, by Commission, to the Heating Appliances (Fireguards) Act.

Both Houses of Parliament have adjourned until Tuesday, 14th October.

London Strike

ABOUT a hundred London Electricity Board employees began an unofficial strike on Tuesday at the Board's Croom's Hill, Greenwich, depot. This is one of the reporting depots for the Board's 700 meter readers, some of whom were involved in a strike last January over the appointment of supervisors.

The Board stated that the strike occurred because two meter readers at Lewisham had been dismissed. Ten of the strikers are meter readers. The Board had found that the dismissed men had wasted time. Similar action had been taken during the past six months against other men found wasting time and it was intended to continue the same policy if necessity arose.

On the question of redundancy, the Board said that 68 meter readers had already left either of their own accord or because of dismissal for wasting time. None of the men had been replaced. On 16th July notices were served on a further 26 and it was proposed to continue this until redundancy among London meter readers had been removed.

Electricity in South Africa

2.—Industrial Expansion

By HAROLD J. BEARD, B.A., M.I.E.E.

THE main industrial expansion in South Africa is associated with the development of gold mining along the Rand to the east and west of Johannesburg and in the Orange Free State. Of the 26 municipalities in South Africa selling over 10 million kWh yearly, Johannesburg, Germiston, Brakpan, Springs, Benoni, Roodepoort, Krugersdorp, Boksburg, Vereeniging, Klerksdorp and Kvoonstad are on or near the Rand within 100 miles of Johannesburg.

The other main industrial areas are at Pretoria and the three chief ports of Cape Town, Durban and Port Elizabeth. Cape Town is also the legislative capital of the Union and the capital of Cape Province. Pretoria is the administrative capital of the Union and the capital of the Transvaal. The remaining larger municipalities are:—

20 to 100 million kWh annually

Bloemfontein ..	Capital and commercial centre of the Orange Free State; judicial capital of the Union.
East London ..	Port and holiday resort with growing industrial areas.
Pietermaritzburg ..	Capital of Natal, educational and industrial centre.
Kimberley	Commercial centre for Northern Cape; site of De Beers diamond mines.
Uitenhage	Rapidly developing industrial area near Port Elizabeth.
Paarl	Educational and agricultural centre with a growing industrial area.

10 to 20 million kWh annually

Estcourt, Ladysmith, Worcester, Stellenbosch and Grahamstown.

South Africa is rich in minerals as is shown by the analysis of the national income for 1950–51:—

	£ (million)
Agriculture and forestry ..	204
Mining, gold	118
„ other minerals ..	41
Manufacturing industry ..	269
Distributive trades	176
Transportation	94
Remainder	212
Total	1,114

The industrial growth has been mainly in light engineering and the smaller types of manufactured goods. The requirements of the armed services during the last war accelerated the expansion of the engineering industry, which made a valuable contribution to the war effort. About 85 per cent of the factories are situated on the Rand. Among the largest foundries is that operated by the new Vanderbijl Engineering Corporation, Ltd., which produces heavy iron and steel castings.

South Africa can now manufacture, fabricate, or assemble many items of power station equipment. While it is impossible to give a complete list, the mechanical equipment includes building steel frames, boiler tubes and pipework up to certain sizes and pressures, dust collectors, tanks, ducts, flues, casings, chain grate stokers, boiler brickwork, lagging, and parts of coal, ash and dust handling plants.

Steady progress has taken place in the manufacture of electrical equipment, and transformers, switchgear, motors, cables, batteries and electric lamps are produced up to certain outputs.

The Standards Act No. 24 of 1945 established a South African Bureau of Standards which is managed and controlled by a Standards Council appointed by the Minister of Commerce and Industries. The work now carried out by the Standards Council was previously undertaken by the South African Standards Institution, which was a voluntary body established in 1909 for the purpose of maintaining standards for South African manufactured goods. With the formation and rapid development of the Bureau of Standards the need for the Institution fell away and its activities have now ceased.

The Standards Council has issued a number of specifications and Codes of

Misreading of the map in Part 1 of this article (*Electrical Review*, 1st August, pp. 219–225) will be avoided by observing that its purpose was to indicate the positions of the power stations within the Union of South Africa with (inset) main power station sites within the Rand undertaking of the Electricity Supply Commission.

Practice and details of these are given in the monthly "South African Standards Bulletin." The electrical specifications mainly cover domestic electrical appliances, lamps and cables.

Under the Standards Act, the Minister may, after taking certain steps, declare a Standard Specification to be compulsory for a particular commodity. There are at present no compulsory standards which affect the electrical industry.

The Standards Council has a standardization mark and special application, under the Regulations dated February, 1950, must be made for permission to apply the mark to any commodity. Permits granted are published in the Government *Gazette*. An annual fee for the use of the mark is payable, depending on the production of the commodity, to cover the cost of routine testing in the Bureau of Standards' laboratories. Certain municipalities have stipulated that electrical appliances sold under their hire-purchase schemes must bear the Council's mark. The use of the mark is not confined to South African manufactured goods.

The Standards Council is at present considering the desirability of introducing compulsory safety specifications for all portable electrical appliances to safeguard consumers against accidents.

Government Purchases

Government departments are among the largest buyers in the Union of various commodities, most of these purchases being effected through the Union Tender Board and Supplies Office. The arrangement in force provides that, in the first place, government departments give preference to and will purchase the product which bears the Standards Council's quality (or S.A.B.S.) mark. In the second place, failing the mark, government departments give preference to the product which conforms to the Council's specifications, if such specifications have already been issued, or, if a Council specification does not exist, then to the "purchasing" specifications which the Council may have prepared at the request of and for the guidance of the government department concerned. Lastly, in cases in which specifications are not available as guides, the products of various tenderers are submitted to the laboratories of the Standards Bureau for testing. The products are tested and classified by the Bureau on a comparative basis, so that the Union Tender Board, or the government department purchasing the product, is able to decide which article in the group of competing products constitutes the most truly economical purchase. Plant imported from Great Britain is generally in accordance with the appropriate British Standards.

Restrictions

There are no special restrictions regarding the importing of electrical plant and equipment into South Africa, except that it is at present necessary to obtain an import licence from the Directorate of Imports and Exports in the Department of Commerce and Industries. In the case of the Electricity Supply Commission, the railways and the mining industry (the last-mentioned being represented by the Transvaal Chamber of Mines) the applications are addressed to these organizations direct as they have a certain measure of autonomy in the issue of permits.

Import control was introduced in 1948 to stabilize the balance of trade and maintain it at a reasonable level. The necessary legislation is promulgated through the Government *Gazette* and rulings are obtained from time to time by the various interested commercial organizations. This information is often published in the "News Letters" of local Chambers of Commerce and their Association.

The Directorate can and does restrict, or in some cases prohibit, the import of goods when supplies are available from Union manufacturers. This procedure does not normally affect the electrical trade except for lamps and cables, motors and transformers up to certain sizes.

The type of import permit depends on the country of origin and is either restricted (soft currency area) or general (all currency areas). At present permits cover a twelve months' period.

Heavy electrical plant and power station equipment are urgently required for the development of the resources of the Union and this need has been very little affected by the import control, except as regards the additional work involved in obtaining permits and clearing shipments at the docks.

Electrical plant and machinery must comply with the regulations issued under the Factories, Machinery and Building

Work Act, 1941, except when the plant and machinery are mainly associated with mining, in which case it must comply with the regulations issued under the Mines and Works Act No. 12 of 1911.

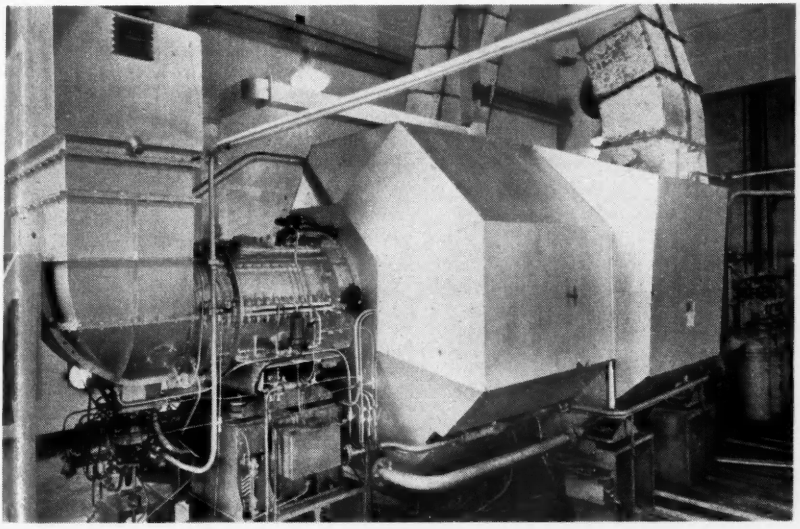
Customs duties are payable on certain materials and plant, but there is usually no duty on machinery, apparatus, appliances, implements and electrical material imported from Great Britain for the generation, transmission and distribution of electricity.

Naval Gas Turbine

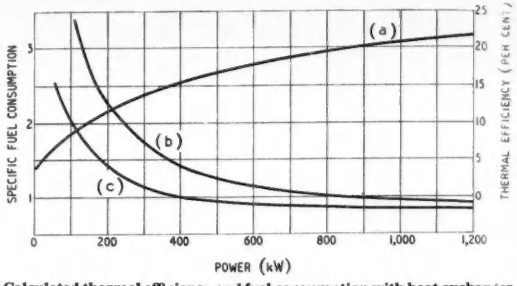
Results of Tests

TECHNICAL particulars of a 1,000 kW gas-turbine alternator built by W. H. Allen, Sons & Co., Ltd., for the Royal Navy were given in the *Electrical Review* of 16th November last. The set had then been on test since the early part of the year without the heat exchanger and reference was made to performance, governing and endurance tests in progress. Last week we witnessed a demonstration of the set after nearly 1,000 hours of running. During this period improvements and modifications were made, principally with regard to means of ignition and keeping the burners free from carbon on shut down. The turbine itself, we were informed, had operated without trouble from the beginning. The measured performance was slightly below that estimated, as shown by the accompanying curves, due to an air leak in the heat exchanger, the annular shape of which, necessitated by space limitations, having introduced difficulties which will be put right on stripping the set prior to delivery to the Admiralty. Design efficiencies of both compressor and turbines have been proved by rig tests and confirmed by engine running.

The 1,000 kW gas-turbine alternator as finally erected in test house



Governing was well within Admiralty requirements whether for steady load changes between zero and full load (for which the compressor speed range was from 4,800 to 8,000 r.p.m.) or for sudden load changes of 25 per cent between one-quarter and full loads. Sudden load swings of 100 per cent off and on had been accepted without trouble in earlier tests. Percentage measured speed changes were: for steady load variations, 1·2; for sudden load increases of 25 to 50 per cent, — 2·5; 50 to 75 per cent, — 2·4; 75 to 100 per cent, — 2·2; for sudden load decreases of 100 to 75 per cent, + 1·55; 75 to 50 per cent, + 2·1; 50 to 25 per cent, + 2·3. During load changes the maximum fuel quantity supplied to the burners was controlled by an air-fuel ratio device and turbine air by-pass valves, operated by the speed control governor, were opened for large load removals. The set when hot was run up within $1\frac{1}{2}$ min; from a cold start, we understand, the time taken is less than twice this figure.

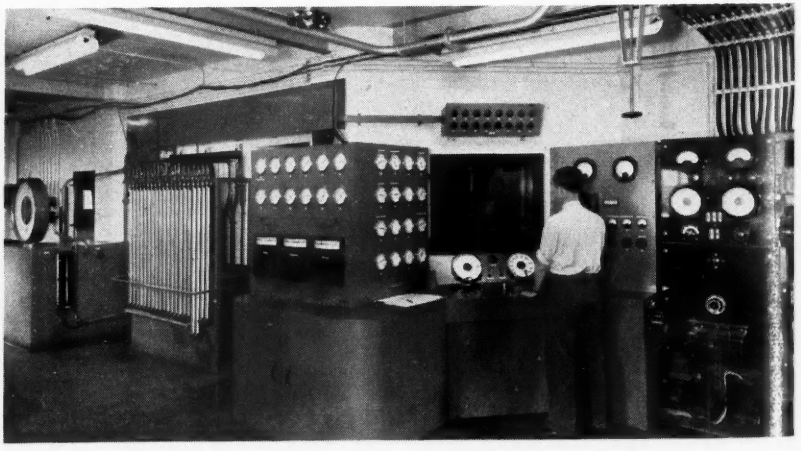


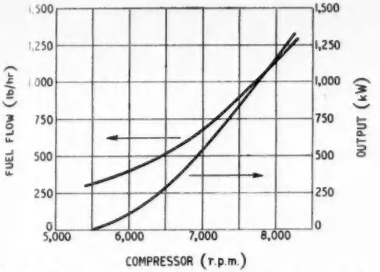
Calculated thermal efficiency and fuel consumption with heat exchanger (a) Thermal efficiency ; (b) lb/kWh ; (c) lb/b.h.p.-hr

The starting procedure was to energize the glow plug, which is situated in one combustion chamber, and to motor up the compressor rotor to 500 r.p.m., when the fuel was turned on. Light-up occurred at about 1,000 r.p.m., after which the set was accelerated by the starter motor and by opening the hand fuel throttle. The motor was shut down at 3,500 r.p.m. At a compressor speed of 4,700 r.p.m. the power turbine reached normal running speed and came under control of the automatic governor ready to be put on load.

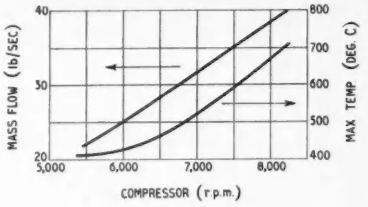
During the visit a 200 h.p. turbo-alternator of novel design which is now under development was observed. Extreme

Instrumentation room in test house, showing from left to right : fuel-weighing gear ; manometers ; couple indicators ; driving panel embodying tachometers, starter motor control, main fuel control and speed control ; thermocouple indicators ; load output electrical panel. Mounted above the driving panel are the combustion chamber light-up indicators





Variations of characteristics with compressor speeds



simplicity, compactness and small weight (600 lb) are the aim. A heat exchanger is not incorporated, efficiency being a secondary consideration in view of the destined use of the set as an emergency lighting generator for marine service.

Electricity in Mines

Principal Inspector's Report for 1950

PARTICULARS of the use of electricity in coal mines are contained in the report for 1950 of H.M. Principal Electrical Inspector of Mines (Mr. J. Cowan), just published by H.M. Stationery Office at 1s 6d.

At 30th June, 1950, the total number of electric motors in use for all purposes at mines under the Coal Mines Act was 92,499 (aggregate capacity 3,070,625 h.p.) The principal applications were as follows:—Haulage 10,626 motors (550,373 h.p.); pumping 10,509 (500,534 h.p.); conveying and loading 14,603 (304,863 h.p.); coal cutting 6,802 (298,816 h.p.); coal cleaning 12,448 (270,912 h.p.); winding 811 (246,230 h.p.); and air compressing 1,015 (216,180 h.p.).

During the year there were two fatal accidents from electric shock. One occurred in the surface power station at a colliery when the electrician-in-charge, a man of long experience, was engaged in making alterations to the switchboard. The other was underground and involved a coal-cutter machine-man who received a shock from the casing of the machine when a live unscreened flexible cable was trapped by the cutting picks after it had fallen from the top of the machine. In addition to these accidents, however, two of the six men who received burns when firedamp was ignited in another accident, died in hospital, and it is presumed that open sparking occurred at the haulage motor sliprings or at the controller, neither of which was of flame-proof design.

One man was killed and three were injured in four separate accidents as the result of the igniting of explosives when a shot firing cable was connected in error to a live electric signalling system.

Although not included in the official returns, a non-fatal accident in which a labourer received a shock from the handle of a lorry is described because it is of interest to electricians and others responsible for the maintenance of substation and electrical apparatus in general. The body of the lorry had been tilted to enable a load of ashes to be emptied on the ground of the electricity authority's outdoor substation situated at a colliery, and the metal part of the frame of the vehicle had come into contact with bare live conductors which were part of the 33 kV system.

Of the 59 non-fatal accidents, involving injury to 67 persons, 15 occurred on the surface and 44 underground involving 17 and 50 persons respectively. Seventeen dangerous occurrences were reported. Such accidents and occurrences during the years 1941–50 are analysed in a table. From this it is seen that in 1950 electric shock and burns were responsible for 48 accidents, ignition of firedamp or coal dust for 9,

fire arising from electrical defects for 12 and other electrical causes 7.

A further analysis allots these accidents to contributory causes as follows:—Design or unsuitability of apparatus 5; installation or maintenance 24; misuse, negligence or ignorance 36; organization and lack of equipment 7; and " unforeseeable " 4.

Switchgear and fuses were involved in 34 cases; flexible cables and plugs in 20; unarmoured cable or wiring in conduit in one; lighting accessories in one; motors and transformers in four; armoured cable or accessories in 11; and in five cases the apparatus involved was unknown.

Details are given by the inspector of the circumstances attending the fatal accidents and of some of the non-fatal accidents; a number of conclusions are drawn and these are discussed in a later section of the report.

Conveyor Braking

There have been a number of fires associated with electrically-operated braking devices on conveyors. In general, the small cables for small solenoids and thrustors are connected directly to the terminals of the stator of the main motor driving a conveyor or hauler. This motor is usually of much larger h.p. in comparison with the solenoid or thrustor and adequate automatic overload protection is required to protect the small cable. Fuses are sometimes provided on the solenoid, but apart from the fact that the small cable is not protected, one of the three fuses may blow and any intended protection be lost.

A small automatic circuit breaker, electrically interlocked with the main motor circuit breaker, would appear to offer the best solution. There should also be provision by means of top and bottom limit switching to ensure that the solenoid plunger travels its full distance. Any failure to complete its travel should result in cutting off all voltage from the main motor and the braking device.

There are still a considerable number of old type switchboards in use, representing one of the outstanding sources of electric shock risks. Mr. Cowan details common shortcomings and says that the remedy lies in the replacement of these boards—generally having switches of inadequate rupturing capacity—by modern switchgear.

Referring to trailing cables, the report mentions the great improvement in this respect. Unscreened cables are being rapidly replaced by screened types, although there are still 230 of them in use at N.C.B. pits.

Trouble has resulted from the damaging of flexible cables by coal-cutter picks. Possibly the best safeguard against this is to always supply the cutter by cable connected to the front, or haulage, end of the machine. If this is not possible some form of guide or " fairlead " should be provided at the goaf side near the rear, or cutting, end of the machine.

There were four cases of " dangerous occurrences " in which there was open sparking from a drilling cable as the result of a short-circuit between conductors. Tests carried out on the gate-end boxes showed that when a short-circuit was applied to the terminals of the boxes, the overload devices failed to operate. The defect was not found only in 150 c/s gate-end boxes, as was first thought, but also in 50 c/s systems. The defect was not confined to one particular design. As the result of discussions, the manufacturers are engaged in the re-design of the protective devices to overcome this serious defect.

Mining Publications

TWO nine-page booklets concerned with the principles of construction and maintenance, respectively, of flameproof equipment and intrinsically safe apparatus have been issued by the National Coal Board, primarily for the instruction of electrical apprentices in the mining industry. They are clearly written in handbook style and illustrated with sketches of flange and spigot joints in the one case and with circuit diagrams in the other. These handbooks, price 9d net each, are obtainable from the N.C.B., Hobart House, Grosvenor Place, London, S.W.1.

Research report No. 38 (price 1s 3d net, Ministry of Fuel and Power, 7, Millbank, London, S.W.1) is a continuation account of the experimental determination by the Safety in Mines Research Establishment of the pressures generated during explosion inside a large core-cooled electric motor. Earlier reports No 11 of 1950 and No. 27 of 1951 recorded the results with explosions of pentane in air mixtures while the third report deals with mixtures of methane in air and of hydrogen/methane in air. The explosion is most violent when the motor is running at full speed and the greatest pressure generated in an explosion of methane in air is then much less than the peak pressure of a hydrogen/methane in air explosion; the latter pressure does not differ greatly from the value obtained with a pentane-air mixture.

CONTRACTS AND SALES

1.—Formation of the Contract

By C. F. MAYSON, A.M.I.E.E.

THIS is the first of a series of three articles dealing with the legal aspects of the simple sales contract applicable to the business of electrical contracting. The purpose is to consider the essentials of the contract as used in the ordinary course of business for the buying of supplies and equipment and the sale of apparatus and installations.

There is a widely held but mistaken impression that a " contract " is a formidable document without which no business transaction of any importance can safely be accomplished. It is hoped to show that this is far from the truth and that every business deal, however small, is a contract, whether there is anything in writing or not. The purely formal contract, being largely a matter for lawyers, is not dealt with; it has, in any case, been very adequately treated elsewhere.*

The basis of a simple contract is the agreement between the parties, arrived at by an offer on the one side and acceptance on the other, and consisting of a promise to do, or refrain from doing, something in return for a consideration. There are thus three essentials—the offer, the acceptance and the consideration.

Making an Offer

In the commercial world an offer is generally made as the result of an inquiry, and is the estimate or quotation given to the customer. An advertisement or the issue of a catalogue is not an offer, save in very rare circumstances, but is merely a communication of information and an invitation to treat. It is doubtful whether the display of goods in a shop window is an offer; it is more probably an invitation. An offer may be withdrawn at any time before acceptance, but withdrawal is not effective until the other party actually knows of it. Passage of time may cause an offer to lapse, either because an acceptance date was specified or a reasonable period has passed. A plain promise to " keep the offer open," made after the offer, is not binding.

Acceptance completes the contract and makes it executory; that is, both parties are bound. If the offer has been made by post, acceptance may be sent through the post and the contract is completed the moment it is posted. In some cases, where the offer is a promise to pay or do something in return for an act, the performance or partial performance of that act may be sufficient acceptance; a familiar example is where a reward is offered for the return of lost property, the contract becoming executory when the property is returned.

Display of Goods

In the relationship of trader and customer it is not always the trader who makes the offer. In a sale " over the counter " it is the customer who offers to buy and the seller completes the contract by handing over the goods in exchange for the price. It is for this reason that a window display is considered to be merely an invitation to make an offer, and a trader cannot therefore be compelled to sell an article just because he shows it to the public.

The consideration is generally in money or money's worth, though it need not be so. The law does not inquire into its adequacy, but it must have some real value; lack of substance may, however, be evidence of fraudulent dealing. It must not be money paid or something done before the contract becomes executory; nor can an unfulfilled obligation, already imposed upon a person by a previous contract between him and another, be taken as consideration for a fresh contract. Thus, if in a contract between " A " and " B," " A " has done his part but " B " has not, and, as an inducement to " B," " A " agrees to do something else provided " B " performs his original obligation, " A "

* As, for example, the late Alfred A. Hudson's " The Law of Building and Engineering Contracts," 17th edition, 1946, by Lawrence Mead (Sweet & Maxwell).

cannot bind "B" under the second contract unless "B" agrees in return to do something else as well.

Void Contracts

An illegal promise or unlawful consideration renders a contract void from the start; and even if it is legal on its face, it will be void if entered into for some unlawful purpose. No action can be taken on such a contract, and moneys paid or goods delivered under it are not recoverable.

A mistake by one or other party may or may not vitiate a contract, but when the mistake is so fundamental as to prevent the formation of a true agreement, the contract will be void. For example, a contract for the supply of something which the parties believed at the time to exist but which had, unknown to either of them, been destroyed, would be a nullity. But an innocent misrepresentation by one party, which has induced the other mistakenly to enter into a contract, does not vitiate it; it only allows the party who has been misled to rescind it if he wants to.

Contracts purporting to exclude the jurisdiction of the Courts are also void, for not only is the intention to create legal relations implied in all contracts, but attempted exclusion is held to be against public policy. An arbitration clause does not, however, amount to an exclusion.

Necessity for Writing

A simple contract may be wholly oral, or partly oral and partly in writing, or it may be evident from the conduct of the parties. In two cases only need it be wholly in writing, in order that it may be enforceable at law; the first is when it is to be performed within one year of its making, and the second where it is for the sale of goods valued at £10 or over.* It may be difficult to decide whether a particular contract is likely to be completed in a year, but if there is any intention or even a mere possibility that it will take longer, it would be as well to follow the safer course and put it into writing.

If the contract cannot possibly last for more than a year and a day, or if it is intended by one party that it shall be completed within a year, or if the period is wholly indefinite, then writing is not required. Where the contract is for the sale of goods it need not be in writing, even if for £10 or more, providing certain conditions (which will be referred to in subsequent articles) are complied with, and it is to be performed within the year.

The writing must be a "Note or Memorandum" setting out the names or descriptions of the parties, the subject matter, the promise and the consideration, and it must be signed by the "party charged," which means the person sued in the event of action, usually the promisee or acceptor. As it is really a question of evidence, for there may otherwise be a perfectly good contract, the "Note or Memorandum" can come into existence at any time before action at law is taken. It need not all be in one document, and letters between the parties, even though repudiating liability, could be sufficient. Contemporary notes of telephone conversations, shorthand notes of discussions and even memos in a traveller's notebook, may all be relevant, and oral evidence is admissible to prove their interconnection. But absence of writing is liable to be troublesome, even if it is not strictly required, so it would be wise in any matter of importance to arrange at least for an exchange of letters setting out the terms in ordinary language.

A written contract is always interpreted on the basis of what the parties intended, such intention being gathered from the document itself. If written, but not required to be in writing, it may be varied or rescinded by subsequent oral agreement; but if it is one which must be in writing to be enforceable, it may only be rescinded orally, and may not be varied except in writing.

Printed Forms

Printed forms are often employed for estimates and orders. These are normally used with written additions and alterations, and such written words have, in law, more effect than the printed ones which, if deleted, are ignored absolutely and may not be looked at even to explain a doubtful meaning. Clauses which are not struck out, but which obviously have no reference to the particular transaction, are rightly ignored; but a clause which can affect the matter and which has not been struck out, although it may appear that it should have been, will be taken into consideration in construing the whole.

* The first is provided by section 4 of the Statute of Frauds, 1677, and the second by section 17 of that Act as re-enacted by the Sale of Goods Act, 1893, section 4.

Special considerations apply where contracts are made with minors, married women and corporations. A contract with a minor should be avoided for, unless it is for the supply of necessaries personal to him, it cannot be enforced, even if he is in fact engaged in business on his own account.

A married woman may now contract as though she were a feme-sole, but difficulty is sometimes found in deciding whether she is contracting on her own behalf or as her husband's agent. Apart from the fact that there is a presumption in law that a wife has her husband's authority to pledge his credit for household necessities, she may have implied, or even actual, authority to do so for other things. Such authority can, of course, be repudiated by the husband, but unless he has given specific notice to each trader concerned he will find it difficult to avoid liability. Contrary to popular belief, the usual notice in a newspaper is, in law, completely ineffectual.

Whilst statutory and chartered corporations must normally employ a formal contract under seal, a simple contract is permitted for everyday matters. A statutory corporation is limited in its powers of contracting to the objects specified in the Act incorporating it, but a chartered corporation has the same scope as a private individual. Limited companies need not use a formal contract, though the subject matter must be within the scope of their articles of association. Any person dealing with a limited company is deemed to have notice of the contents of its memorandum and articles,* and is therefore credited with knowing whether a particular contract is within its powers. But an act by one of the company's officers, which is ostensibly within the articles and is not attended by any suspicious circumstances, will bind the company, even though the officer had no authority to act.

Nobody who is not an original party to a contract can be bound by it or benefit from it. An apparent exception to this is the sale of debts to a debt-collecting firm; another is the case of partnership, for a partner can bind all the other partners. In fact, neither are true exceptions, for the first is virtually a fresh contract and in the second the partner is acting as his firm's agent.

* This may be inspected at the office of the Registrar of Companies, Bush House, Strand, London, on payment of a small fee (Companies Act, 1948, section 426).

B.E.A. Contracts

Total for Past Month £12·6 Million

DURING the past month the British Electricity Authority has placed contracts for equipment for power stations, transforming stations, and transmission lines to a total value of £12,629,687. The principal contracts include the following:—

Cowes power station: Two 135,000 lb/hr boilers.—Daniel Adamson & Co., Ltd.; steel frame for office block, turbine house and boiler house.—Peirson & Co., Ltd.

Goldington station, Bedford: Two generator transformers.—Hackbridge & Hewittic Electric Co., Ltd.

Tilbury station: Precipitator casings.—Bierrum & Partners, Ltd.; steel frame buildings.—Alex. Findlay & Co., Ltd.

Drakelow station, Burton-upon-Trent: Coal handling plant.—Mitchell Engineering, Ltd.

Northampton station: Two 150,000 lb/hr boilers.—Bennis Combustion, Ltd.

Meaford "B" station, Stone, Staffs.: One cooling tower.—Davenport Engineering Co., Ltd.

Bold station, St. Helens, Lancs.: One cooling tower.—Film Cooling Towers, Ltd.

Connah's Quay station, near Flint: Superstructure of power station, south block and ancillary buildings.—J. Garrard & Sons, Ltd.

Ince station, near Ellesmere Port: Ash and dust handling plant.—Babcock & Wilcox, Ltd.

Doncaster stations: Structural steelwork.—Wright, Anderson & Co., Ltd.

Skelton Grange station, Leeds: 3,300 V and 415 V switchgear.—English Electric Co., Ltd.

Stella North station, near Newcastle-upon-Tyne: Foundations for main and ancillary buildings.—Sir Robert McAlpine & Sons, Ltd.; three 60 MW turbo-generators, condensing and feed heating plants.—C. A. Parsons & Co., Ltd.; low pressure piping equipment.—Aiton & Co., Ltd.

Stella South station: Four 60 MW turbo-generators, condensing and feed heating plants.—C. A. Parsons & Co., Ltd.

Chadderton station, Oldham: One cooling tower.—Fred Mitchell & Son, Ltd.

Clyde's Mill station, Glasgow: Foundations for extensions.—Holst & Co., Ltd.

Carrington substation, near Manchester: 90 MVA 132 kV oil-filled reactors.—Hackbridge & Hewittic Electric Co., Ltd.

Staythorpe (Newark)—Elstree 275 kV twin 0·4 sq in overhead line.—British Insulated Callender's Construction Co., Ltd.

Llantarnam-Crumlin, Mon.: 132 kV overhead line.—J. L. Eve Construction Co., Ltd.

Compulsory Wayleaves

The Ministry of Fuel and Power has granted compulsory wayleaves to the North-Eastern Electricity Board to supply electricity to Danby Wiske and Wiske Moor.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Losses in Three-phase Networks

WITH reference to the article by Dr. T. F. Wall relating to single-phase loads, appearing in your 25th July issue, it may be of interest to notice that the relative values of the copper losses may also be deduced very simply as follows:—

It is easy to show that the line current of a balanced three-phase load is numerically equal to the positive and negative sequence symmetrical components of the current supplied to a single-phase line-to-line load taking the same power as the three-phase load, the power factor being the same in each case. Hence it immediately follows that the copper loss in the supply circuits, being equal to the sum of the losses due to the symmetrical components, is twice as great with the single-phase load as compared with the loss due to the three-phase load of equal power. This is Dr. Wall's result.

S. A. SWANN.

University of Nottingham.

Light-Gauge Conduit

REFERRING to the recent correspondence appearing in your journal on the use of light-gauge conduit, I recollect seeing a curious installation of this nature being fitted into some flats in Russia about 35 years ago. At the time, my father occupied one of the flats as the spinning master at a Swiss cotton mill, and although I had no technical knowledge of electricity at the time I was very intrigued by the pipework fitters who installed the wiring and their methods stuck in my mind.

Their conduit I should now judge to be of zinc, having walls about 20 thousandths thick, and about 1in diameter, and it arrived in lengths of about 10ft. The tubing was fastened to the surface of the walls by saddles and a special tool was used to obtain a fairly sharp right-angle bend by "crimping" the inside radius, and also I have a clear recollection of the end of the tube being opened out into a bell mouth by the use of another special tool.

I am not too clear as to the method of joining the lengths of tubing on the run as I cannot recollect seeing that operation, but I think they were socketed after one end had been swaged out to accept the adjoining length.

A type of v.i.r. wire was then drawn into the tubes in a similar manner to present-day practice and switches were fitted on wooden blocks two or three inches away from the bell mouth of the conduit and the emerging wires were coiled into two or three turns of a helix before passing into the switch, no protection being afforded to these wires. I never saw the connection to the ceiling rose, as the surface conduit disappeared into the plaster of the ceiling and the wiring was continued out of sight from below.

Unfortunately, I have no particulars of the voltage in use, nor had I the knowledge at the time to be able to say whether earthing of the conduit was carried out, although I rather doubt it, but I did wonder upon reading your correspondence whether we might be heading for something similar, with of course, a completely enclosed system adequately earthed, etc.

Luton, Beds. WILLIAM BUCKLEY.

Water Power in Guatemala

A SURVEY of economic and commercial conditions in Guatemala (H.M. Stationery Office, 1s) indicates that the available resources of hydro-electric power have been by no means fully exploited. There has been a steady growth of demand for electricity and its wider use would contribute greatly to the development of the country's economy. To meet the present demand there is a total generating capacity of about 35,000 kW. Approximately four-fifths of all electrical services in the country are supplied by the Empresa Electrica de Guatemala, a subsidiary of American and Foreign Power, and of this total about 92 per cent is sold in the Guatemala city area. There are a few publicly-owned plants which serve the smaller towns and villages.

Sealing Metal to Glass

Problem of Varying Rates of Expansion

By R. H. WARRING

IN the design of electrical components enclosed in glass envelopes one of the major problems encountered is how to seal, through the glass, those conductors which connect the inside electrodes to outside circuits. When the internal metal parts have to be held in position rigidly by glass formers, or stems, the supporting area of glass is generally arranged also to be the lead-out point so that only one glass-to-metal seal is needed.

The main difficulties arise from the different rates of expansion of various kinds of glass and of most metals. Thus, when the metal conductor is electrically heated under working conditions, it sets up mechanical stresses within the glass seal; also, since the glass envelope is often exhausted or filled with an inert gas at less than atmospheric pressure, the seal must retain perfectly its air-tightness throughout a range of possible operating temperatures. Radio valves, cathode-ray tubes, fluorescent tubular lamps, electric lamp bulbs and a host of other items come into this category.

In the case of a typical lamp (Fig. 1) the filament leads have to be taken through the glass bulb down to the base terminals and the seal so formed between metal and glass must be complete at all temperatures. The seal itself has originally to be made at a relatively high temperature at which the glass is viscous enough to permit the metal lead to be fitted. While cooling down to room temperature, if the glass contracts more than the metal, it will set with a localized compressive strain which may be sufficient to crack it. If the metal contracts more than the glass, then there is the possibility of the seal being destroyed; or, when heating up to working temperature, of the expanding metal cracking the glass again.

The logical solution is to use a metal which has about the same coefficient of expansion as glass, as was done in the manufacture of the earlier types of electric lamps. The choice of glass available was limited and one metal (platinum) matched the thermal expansion characteristics of that glass fairly closely. It was a far from ideal solution, however, for platinum is expensive and so was used only for that section of the lead actually forming the seal. Separate (cheaper) metal extension leads were attached to both ends on either side of the seal. This saved on the cost of platinum, but added to the cost of production by requiring a multiplicity of joints.

A better method was eventually found, which is still widely employed to-day in the manufacture of electric lamps and a large variety of radio valves. This was to employ a nickel-iron alloy wire for the leads with an outer coating, or sheath, of copper.

The nickel-iron alloy has a thermal expansion coefficient somewhat lower than that of the type of glass commonly used for the envelopes. The addition of the copper coating raises this coefficient to about the same as that for glass, but the copper also forms a shock-absorbing interlayer in the seal proper. In other words the softer copper yields slightly, or deforms, under differential expansion and contraction of the seal, thus absorbing the stresses set

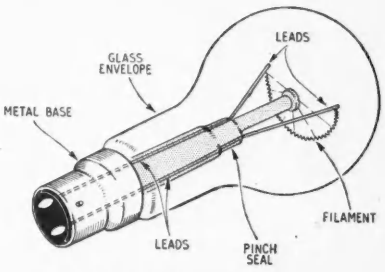


Fig. 1—Typical lamp bulb assembly

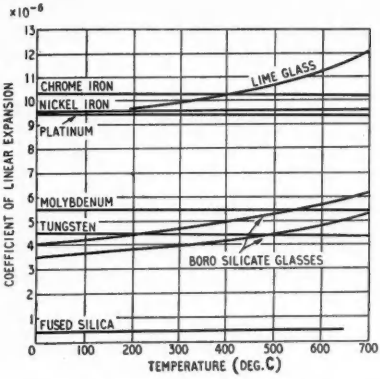


Fig. 2—Graphical summary of expansion data

up rather than allowing them to accumulate in the metal or glass.

It would appear at first sight that there should not be any residual stresses in a metal-to-glass seal when the thermal expansions of both the glass and metal are similar, but unfortunately this simple rule does not apply. The thermal expansion of most metals is linear; it increases linearly with rising temperature whereas in the case of glass the coefficient of expansion (or the increase of length per degree temperature rise) increases at the higher temperatures. Some typical data are summarized in Fig. 2. The seal, it will be remembered, has originally to be made at a relatively high temperature corresponding to the softening point of the glass.

The unavoidable difference between thermal expansion characteristics can, so far as physical effects are concerned, be absorbed by relatively thin copper—copper wire, or the copper coating of a metal wire, or a copper tube, but not a solid copper rod. Thin copper, in fact, will form a satisfactory seal in almost every type of glass, but thin copper wire is very rarely used alone because of the possibility of early fracture as the wire itself is subject to cyclic periods of stressing under normal working conditions.

Glasses used for envelopes when a metal-to-glass seal is called for are usually one of two types: low-expansion boro-silicate glass (which has excellent mechanical strength and thermal shock resistance properties) and soda-lime-silica glasses (similar to normal commercial glass), with a much higher coefficient of expansion. For specialized work true silica glass, or fused silica, is sometimes employed, although difficult to work and costly; fused silica has a very low coefficient of expansion.

Boro-silicate glasses generally have coefficients of expansion ranging from about 3·5 to 5 $\times$ 10^{-6}/deg C and corresponding figures for typical soda-lime-silica glasses are 9 to 10 $\times$ 10^{-6}. Tungsten and molybdenum are two metals having a similar expansion coefficient to that of boro-silicate glasses and this property can be duplicated by various nickel-iron-cobalt alloys. Platinum has a similar thermal expansion coefficient to soda-lime-silica glasses and can be duplicated in this case by alloys of the nickel-iron or chromium-iron types.

Choice of the correct alloy for the type of glass forming the envelope results in matched seals and the colour of the seal used is generally a good guide to the type of metal used (Table I), the colouring being due to the formation of oxide on the surface of the metal (Table II) which to a certain extent acts as an interlayer between the glass and metal and prevents intimate

TABLE I—METAL-TO-GLASS SEALS: COLOUR DEFINITION

Type of glass	Type of seal	Metal	Colour of seal
High expansion (Soda-lime-silica)	Unmatched	Copper	Red
	"	Molybdenum	Bright metal
	"	Tungsten	Bright metal
	"	Copper-nickel alloy	Red
	Matched	Platinum	Bright Metal
	Matched	Nickel-iron alloy	Grey
	Matched	Chrome-iron alloy	Green
Low expansion (Boro-silicate)	Unmatched	Copper	Red
	Matched	Molybdenum	Brown
	"	Tungsten	Yellow
	"	Iron-nickel-cobalt alloy	Grey
Fused silica	Unmatched	Molybdenum foil	Metallic

contact between them. This interlayer has the desirable effect of preventing bubble formation at the metal-glass junction during forming which might otherwise result in a faulty seal. The thickness of the oxide layer is also of considerable importance. The oxide bonds more readily to the glass than to the metal while at the same time intermolecular attraction between the metal and its oxide layer is strongest when the oxide film is thinnest. Hence an optimum thickness must be established and, again, the colour of the finished seal is a guide.

The type of seal previously mentioned as employing a copper shock-absorbing interlayer is often called a mis-matched seal. Strictly the definition applies where the coefficients of expansion of metal and glass differ considerably. The resulting stresses are absorbed by the metallic component. Instead of fine copper wire, or copper tube, however, it is possible to use very thin strips of harder metals, thin enough to deform under any stresses generated in the mis-matched joint, yet still strong enough to resist fracture. Seals of this kind are generally known as foil seals (Fig. 3) for the metallic strip used is normally about one-fifth to one-quarter of an inch wide but only between 0·0005 and 0·001 in thick. This is a particularly useful method of making metal-to-glass seals in silica glass, which has a thermal expansion coefficient of only $0{\cdot}5 \times 10^{-6}$. Current carrying capacity is somewhat limited on account of the small cross section of the metal conductor, but a number of foil strips can be used in a single seal. Alternatively, and now becoming common practice, a matched seal is made in a suitable glass and is, in turn, sealed to a second and different type of glass, then again to a third type of glass which is identical with that of the envelope.

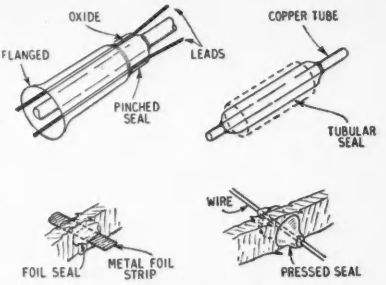


Fig. 3—Four examples of different types of seal

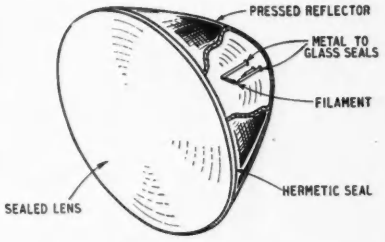


Fig. 4—Sealed-beam motor-car headlamp

The built-up seal is then welded or otherwise secured to the envelope.

An interesting modern example of the importance of metal-to-glass seals is the sealed-beam motor-car headlamp now employed in the United States. Its front glass and parabolic shaped cup, or reflector, is moulded as one. The front glass, or lens, may actually be made separately and then fused to the reflector, but the principle is the same. The interior is hermetically sealed and the whole does, in fact, become the envelope of the lamp (Fig. 4).

Metal to glass *bonding* is in a different category for in this case the principle is

TABLE II—METAL-TO-GLASS SEALS: METALLIC OXIDES

Metal	Fused silica	Boro-silicate glass	Soda-lime-silica glass
Copper	Red cuprous oxide	Red cuprous oxide	Red cuprous oxide
Molybdenum	None	Brown dioxide (MoO_2)	—
Tungsten	None	Mixed oxides	None
Platinum	—	None	None
Nickel-iron alloy	—	—	Mainly Fe_3O_4
Chromium-iron alloy	—	—	Chromic and ferric oxides
Nickel-iron-cobalt alloy	—	Mainly Fe_3O_4	—

to apply a metallic layer over the surface of the glass and intimately bonded to it. It is an excellent, probably the best, method of attaching metal fittings to glass: first applying a bonded metallic layer and then soldering the metallic fittings in place. Modern technique, too, can now weld metal to glass so that envelopes of mixed (metal and glass) construction can be employed, which is of particular interest in the development of larger cathode-ray tubes. Metallizing, or the applying of a thin bonded metallic layer, also provides a hermetic seal which is likely to have increasing application in the field of protective coatings.

STREET LIGHTING NOTES

IN his report for 1951–52, Mr. C. J. Chisholm, lighting engineer of Sheffield, records that owing to lack of materials, and after consultation with the Yorkshire Electricity Board, the Corporation was unable last year to proceed with the proposed conversion from gas to electricity, but the engineer says that it is hoped to re-start this work next year. The chief activity during the past year was the lighting of new estates, on which 381 additional lamps were brought into use. At the end of March there were altogether 16,142 electric lamps along 304 miles of streets; they consumed 492,091 kWh at a cost bout £22,105. In contrast, the gas supplied to a smaller number of lamps (12,188 along 407 miles of streets) cost £24,500. The city's electric lamps are mostly of the filament kind, but a trial installation of 30 sodium lamps was erected in the year under review.

LEICESTER City Council proposes to apply for consent to borrow £20,000 for providing street lighting on various Corporation and new private housing estates.

EASINGTON-WITH-THORPE Parish Council (Co. Durham) is seeking Ministry sanction to spend £2,900 on street lighting improvements in the Colliery Ward area.

LIVERPOOL Corporation Lighting Committee in the year ahead proposes to carry through the following improvement schemes:—Conversion of gas lighting to overhead electric lighting in Rathbone Road, Wellington Road and Myrtle Street; sodium lighting scheme for Park Road; fluorescent lighting for Pier Head north bus terminal. Electric wall lanterns will replace gas lamps in more passages.

STOCKPORT Corporation has received loan sanction for the conversion of a further 226 lamps from gas to electricity in 24 streets at a cost of more than £9,000.

BEDFORD Town Council proposes to extend fluorescent lighting in Ampthill Road at estimated cost of £3,000.

CHESTERFIELD Street Lighting Committee has approved the conversion of street lighting in Stand Road, Whittington Moor, from gas to electricity, and new lighting in Hallowes Place. The lighting engineer has prepared a scheme for improving lighting in Hasland Road at estimated cost of £3,148.

NEWCASTLE-ON-TYNE City Council is to spend £5,975 on the erection of 45 street lamps on the Montagu housing estate and 194 on the Slatyford estate.

BROADSTAIRS U.D.C. has approved a scheme for Class A lighting in Queen's Road and Ramsgate Road at a cost of £1,820, subject to the usual sanctions.

BOLDON (Durham) U.D.C. has received sanction to borrow £1,272 for electric street lighting at Boldon Colliery, West Boldon and Cleadon Lane.

READING Housing Committee proposes to carry out by direct labour a scheme for the installation of street lighting on site No. 7 of the Bath Road housing estate, at an estimated cost of £3,200.

BOSTON Town Council is considering improving the street lighting in Church Road, Fistoft Road, Tooley Street and Charles Street.

STAMFORD Town Council is to convert street lighting from gas to electricity in Conduit Road, Emlyns Street, Recreation Ground Road, King's Road, Cliff Road, Sussex Road and Cliff Road, in addition to the trunk road through the town.

BLACKPOOL Corporation has approved a scheme submitted by the public street lighting officer, estimated to cost £59,200, for street lighting improvements. The plans are to be submitted to the Ministry of Transport.

EDMONTON Borough Council Works and Highways Committee reports that a scheme for improved street lighting on the Great Cambridge and North Circular Roads is now receiving the consideration of the Ministry of Transport.

GUILDFORD Corporation Works Committee recommends approval of schemes submitted by the borough surveyor for the provision of street lighting in Aldershot Road from the Wooden Bridge Hotel to the borough boundary at a cost of £3.400 and for the improvement of the lighting in Onslow Street (£1,600).

RECENT INTRODUCTIONS

Notes on New Electrical and Allied Products

Electric Hoist

THE TAYLOR STOKER CO., LTD., 189/191, Drummond Street, Euston, London, N.W.1, has recently extended its range of electric hoists by the introduction of a new design with greatly increased height of lift. This new model embodies all the usual features of the original type, but is fitted with a bottom block having only two falls of rope instead of four, giving nearly twice the lift height for the same load, at the same speed. The present range caters for loads of up to 3 tons. A further feature is the introduction of a rope guide to ensure that the rope winds evenly on the drum in spite of any carelessness on the part of the operator.

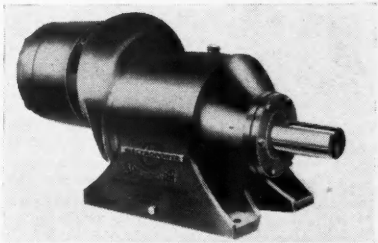
The hoist is operated by means of a push-button station. It can be supplied with plain trolley wheels for push travel or geared travel or power travel. A limit switch, governed by the revolutions of the drum, provides an automatic cut-out at the top and bottom limits of the lift height. The gear box is totally enclosed and forms an oil bath for the train of spur gears. A mechanical brake in the gear box controls the lowering speed, while an electromagnetic brake on the motor prevents any tendency for the load to drift.

"Lo-Hed" hoist with increased height of lift

Speed-Reducing Units

ELECTROPOWER GEARS, LTD., Kingsbury Works, Kingsbury Road, London, N.W.9, have recently introduced two speed-reducing units. Type E.S.R.6 is a single reduction spur gear box, manufactured in one size only, and covers a range up to 1 h.p. maximum. The speed range, using 4-pole motors, is from 306 to 616 r.p.m. inclusive, with ratios from 2·31 : 1 to 4·65 : 1 inclusive. The "Speedreducer" is a small compact unit, and can be mounted in any position. The gear box can be turned on the motor face to bring the output shaft below the centre line, or any intermediate position.

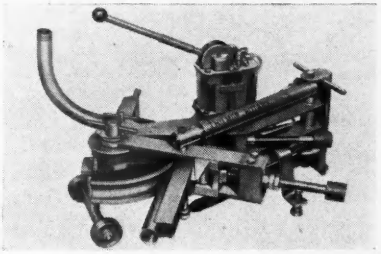
The vertical model, type E.S.R.V.6, is identical, but it is for flange mounting and it also makes a satisfactory built-in unit. The unit can be fitted with multi-speed motors to give two, three or four individual speeds and it is suitable for running in either direction.



Type E.S.R.6 speed-reducing unit

Hydraulic Conduit Bender

Claimed to be an entirely new type of conduit bender, the "Rotary No. 3" hydraulic bending machine recently introduced by HILMOR, LTD., 65, Calshot Street, London, N.1, is completely



Hilmor "Rotary No. 3" conduit bender

portable, needing no fixing or bolting down. The machine is light and speedy in action, requires no heavy manual effort and is capable of producing ripple free bends in light and heavy gauge conduit up to 2in outside diameter. The machine will produce simple or compound bends in addition to the many types of bends required for normal installation purposes.

Cable Straps

The "Helvin" cable straps obtainable from HELLERMAN ELECTRIC, LTD., Tinsley Lane, Crawley, Sussex, fit any size of wiring loom and their use permits easy withdrawal or addition of cables to the loom. Made from plasticized p.v.c., the straps take the form of a perforated strip measuring ¼in in width and are fastened by means of a miniature "collar stud." They may be supplied in any required length, complete with studs, and the makers claim that this new labour-saving accessory replaces the now out-of-date method of lacing cable forms.

Room Thermometer

Suitable for enabling the householder to assess the economic efficiency of home heating, an improved room thermometer made by HURSEAL, LTD., 229, Regent Street, London, W.1, operates between 30 and 110 deg F, working on a positive bi-metallic thermostatic principle, with a movable dial. It has a metal and Bakelite case and measures 2⅞in high, 2½in wide and 1⅛in deep. The price of the thermometer is £1 17s 6d.

Leak-Proof Alkaline Cap Lamps

FOLLOWING extensive investigations into the causes of electrolyte leakage from miners' cap lamps, Nife Batteries, of Redditch, have introduced a nylon safety vent which ensures that all alkaline cap lamps can now be operated in a completely dry external condition.

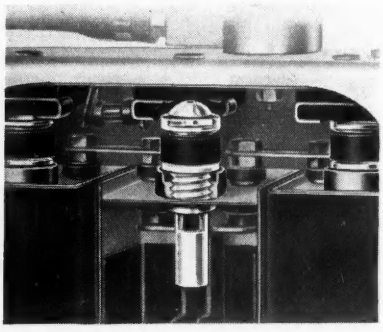
Vent leakage was found to be due to one or more of four different causes—spraying during charging, the pressure ejection of liquid through the vent while the lamp is in service, over topping-up and badly fitting seating washers. It is claimed that the nylon safety vent, which replaces the steel vent, eliminates these faults.

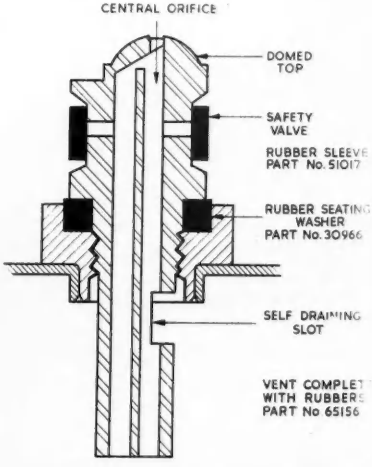
The opening of a Nife cap lamp battery lid for charging now automatically opens the central orifice of each vent so that charging gases can escape without hindrance. The body of the vent contains two columns of unequal height and these, combined with a self-draining slot and a free gas exit, remove all possibility of electrolyte spray. At the end of the charge the cells are at atmospheric pressure and their tops completely dry. On closing the battery lid, the cells are sealed at atmospheric pressure. This ensures, in conjunction with the self-draining device, that no leakage takes place in service even though the lamp is operated for long periods in a horizontal position.

It is now no longer necessary to remove the vents before topping-up. This operation is carried out through the central orifice by means of the special Nife topping-up equipment which cuts off the flow of water automatically as soon as the correct electrolyte level is reached.

The introduction of the new vent system, which is adaptable to all Nife three-cell cap lamps, offers many advantages. Maintenance is made easier and costs are reduced by the absence of spillage.

The new Nife nylon vent system with battery lid closed. Right: Vent in section





Commerce and Industry

Engineering Wage Claim Rejected

Diesel-Electric Locomotive Contract

THE Engineering and Allied Employers' National Federation has rejected the claim of the Confederation of Shipbuilding and Engineering Unions for a wage increase of £2 a week for more than two million engineering workers. At a meeting last week when the decision was announced it was stated that the employers had refused the unions' demand because it was against the national interests in present circumstances; in spite of the unions' contention, the claim was unjustified by the profits of the industry, already heavily taxed; and it was unwarranted by the rise in the cost of living, against which there had been compensations such as reduced personal income tax and an increase in family allowances.

Sir Alexander Ramsay, director of the Engineering and Allied Employers' National Federation, said that if the employees in other industries were to seek similar advantage the cost to the nation might be in the region of £2,500 million annually, a staggering blow to national solvency and living standards. The employers would not be unwilling to reward increased individual effort, but to raise costs of production was a sure way to depression and unemployment. Germany and Japan had again become challengers in world markets and what was needed to safeguard Great Britain's future was a wholehearted effort in every industry to produce more at less cost. Every adult male engineering worker had received a wage increase of 11s a week and an extra week's holiday as recently as last November.

Flour Mill Conveying

At the Hovis Mill, Westminster, the substitution of Woods multi-stage high pressure contra-rotating "Aerofoil" fans for centrifugal fans has substantially reduced power consumption for pneumatic flour conveying and has introduced a new degree of flexibility of operation and a saving in space. The mill has a capacity of 33 sacks an hour (132 tons a day) and the Henry Simon pneumatic conveying system has 75 lifts divided into three separate sections to obtain the greatest economy in power consumption. Each of these sections has its own five-stage "Aerofoil" unit, two stages of the fan being situated on one side of a 90 deg bend and the remaining three stages on the other. With each fan the fifth stage is used for boosting the pressure during the starting-up period or during power cuts; normally this stage is switched off and idled with a consequent saving in running cost. The three multi-stage fan units together represent 38 h.p., whereas centrifugal fans would have required about 59 h.p.

"Aerofoil" multi-stage fans in the pneumatic conveying system of the Hovis Mill, Westminster

Apsley House Restoration

An extensive programme of restoration has been carried out by the Ministry of Works at Apsley House, London, which was the home of the first Duke of Wellington and was presented to the nation by the present Duke.

Special attention has been paid to the lighting. Such original candelabra and chandeliers as remained have been restored by the Victoria and Albert Museum and adapted for electric lighting by the Ministry of Works. Other chandeliers on the main staircase and on the ground floor have been purchased by the Victoria and Albert Museum. Some rooms have, in addition to the chandeliers, fluorescent lighting behind the cornices, and the Waterloo Gallery

has additional lights behind the glass ceiling panels. The Napoleon statue in the staircase vestibule is illuminated by spotlights. A mechanical ventilation system has been installed in the Waterloo Gallery.

The contractors for the electric lighting and power installation were G. W. Day & Co., Ltd., and new lifts were supplied by Evans Lifts, Ltd.

Battery-Operated Lift

Probably the first electric passenger-goods lift to derive its power entirely from a storage battery is now in operation in the boot and shoe factory of Smith Faire & Co., Ltd., Leicester. The 4½ cwt lift cage is driven through a worm gear by a 100 V 3 h.p. d.c. motor, and travels at 82 ft/min. The installation was carried out by Gimson & Co. (Leicester), Ltd. Eighty-four " Nife " steel-alkaline cells with a capacity of 35 Ah have been installed. The control cubicle provides automatic charging via voltage relays—a system which reduces maintenance considerably. The lift motor, taking a starting current of 56 A, draws 28 A from the battery under full load. The push-button control gear represents 200 W.

Electricity at Cork University

Aided by a bequest and a government grant, University College, Cork, plans to inaugurate a Department of Electrical Engineering within two years. Dr. Alfred O'Rahilly, president of the College, in announcing this at the summer conferring of degrees, said that the lack of facilities for training electrical engineering students had long been felt.

Ediswan Birmingham Office

The Birmingham office of the Edison Swan Electric Co., Ltd., is now in new premises at Swan House, 10, Hospital Street, Birmingham, 19, and all future inquiries should be made to that address. The telephone number remains the same as previously (Central 6411/2) and the new premises include a trade counter.

New Edison Swan premises in Birmingham

Batti-Wallahs' Society

The companionship of the sea formed the topic of an address given by Sir Patrick Hannon at the monthly luncheon of the Batti-Wallahs' Society on 30th July. Sir Patrick referred particularly to the dependence of ships on the electrical engineer and paid a warm tribute to the activities of the Society. Mr. J. W. Perkins presided at the luncheon. At the next function on 24th September the guest of honour will be Mr. Boyd-Carpenter, Financial Secretary to the Treasury.

Naval Engineering Commissions

National Service R.N.V.R. engineering and electrical officers serving in the Royal Navy can now apply for permanent commissions in the Royal Navy under the " University Candidate " scheme of entry. The Fleet Order announcing this explains that applications can be made after completion of one year's service. Conditions of entry will be identical with those applying to university candidates who are not doing their National Service, except that certain time served as temporary officers will be counted for seniority purposes.

Locomotives for the Gold Coast

The English Electric Co., Ltd., has recently secured an order from the Gold Coast Railways for ten 750 h.p. diesel-electric locomotives. The locomotives are of the BoBo type; they weigh 52 tons in running order and are for 3ft 6in gauge. The maximum axle load is 13 tons and the locomotives are designed for passenger or freight train working. Power is transmitted to the road wheels by means of four traction motors and provision is made for multiple-unit working.

This contract follows closely on the recent conference of Colonial railway chief mechanical engineers, under the chairmanship of Mr. A. Campbell, chief mechanical engineer of the Crown Agents for the Colonies, who discussed future standards for their narrow gauge railways.

Advanced Welding Course

An advanced welding course is to be held at Kingston Technical College for 15 weeks, on Monday evenings commencing on 29th September. The course is intended for those engaged in industry who require training in advanced welding processes to extend their knowledge to enable them to introduce new methods into manufacturing processes. The emphasis will largely be on resistance welding and the gas-arc systems in common use. The welding laboratory is fully equipped for all normal training requirements. Further details of the welding courses

may be obtained from the Head of the Engineering Department, Kingston Technical College, Fassett Road, Kingston-upon-Thames.

Televised Operation

Delegates from all over the world, attending the recent 11th International Dental Conference in London, saw an operation televised and projected on to a large screen—the first time this technique has been employed in a British hospital. A Marconi "Image Orthicon" television camera was mounted above the operating table and larger-than-life close-up details of a cleft palate operation were seen by large numbers of the delegates in the viewing theatre five floors below.

Taxation of Profits and Income

A second memorandum which it has submitted to the Royal Commission on the Taxation of Profits and Income has been published by the Federation of British Industries, 21, Tothill Street, London, S.W.1 (price 1s 4d). This supplements the Federation's earlier evidence embodied in three published documents.

Tin Research Council

The International Tin Research and Development Council is in future to be known as the International Tin Research Council. This change will not affect the policy of the Council nor alter its current activities.

Public Transport Association

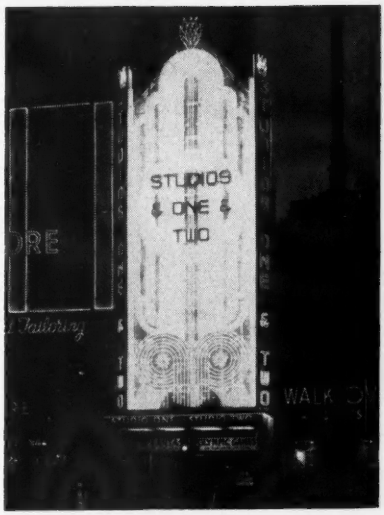
The annual luncheon of the Public Transport Association will be held during the period of the Commercial Motor Show, and will take place at the Connaught Rooms, Great Queen Street, London, W.C.2, on 3rd October next. It is hoped that Mr. A. T. Lennox-Boyd, Minister of Transport, will attend as the principal guest.

The Council of the Association has decided that the Association's 1953 Conference shall be held at Folkestone from 21st to 23rd April.

Large Sign Installation

Believed to be the largest single display of its kind in the United Kingdom, a new sign installation has just been completed at Studios One & Two, Oxford Street, London, W.1, employing a general scheme of cold cathode lighting. It incorporates the front elevation of the theatre, front and returns of the canopy, five flambeaux and two vertical signs 46ft 6in by 2ft 6in reading "Studios One & Two." Other vertical and horizontal signs advertise the cinema names, "New News" and "News Theatre."

The colours selected for this scheme are fluorescent blue, pink, green, off-white, warm white, ruby red and opal red. The total length of glass tubing in the display is 3,300ft, giving a total load of 96 kW. There are 97 circuits



Cold cathode sign in Oxford Street, London

controlled by 97 transformers housed across the apex of the roof in step formation, enabling maintenance to be carried out without removing any glass tubing.

Ionlite, Ltd., was responsible for the manufacture of the sign and the h.v. wiring, Escott Bros., Ltd., carrying out the l.v. work.

Lifts for L.C.C. Flats

To overcome as far as possible the difficulties in providing passenger lifts at the appropriate stage in the construction of blocks of flats at London County Council estates, the Housing Committee earlier this year arranged for the manufacture and installation of 100 eight-person lifts to be installed by June, 1953, and 100 lifts in the second half of that year. As a further step it is now proposed to invite tenders for another 100 lifts to be available for installation early in 1954. The estimated cost is £270,000.

Radio and Television Relay Apparatus

Under the Purchase Tax (No. 2) Order, 1952 (S.I. 1952, No. 1423), domestic radio and television relay apparatus and loudspeakers for use with taxable wireless sets are now chargeable with purchase tax at 66⅔ per cent, thus ensuring that they are taxed at the same rate as the radio and television sets which receive broadcast programmes direct. In the case of goods not previously taxed the Order applies to goods which are delivered on sale, or appropriated to retail trade or similar purposes, on or after 4th August, and to imported goods

which are imported and entered, or which are delivered from bonded warehouse for home consumption, on or after that date. The tax applies to all types of reproducer unit for use in the homes of subscribers to radio and television relay systems, and to loudspeakers suitable for use with receivers of the domestic, portable or road vehicle types, whether as extension or integral loudspeakers and whether mounted or not.

E.I.B.A. Balance

In our report of the annual general meeting of the Electrical Industries Benevolent Association (*Electrical Review*, 25th July, p. 195) we said that there had been an excess of expenditure over income of £1,108. We are informed that actually there was a balance of £682 in the other direction. Whatever the explanation our editorial representative at the annual general meeting was handed a copy of the revenue account which gave the figure which we quoted.

Copper Price Agreement

The Ministry of Materials has arranged with its main Commonwealth suppliers for the price of copper to be fixed for a minimum of six weeks from 1st August. By this arrangement the Ministry has been able to reduce its selling price by £2 to £285 a ton.

Trade Announcements

Elcontrol, Ltd., specialists in industrial electronic control equipment, have moved into larger premises at Wilbury Way, Hitchin. At the same time their range of standard items is being increased. The company's sales headquarters remain at 10, Wyndham Place, London, W.1.

To increase its service facilities in the Birmingham area the **British Vacuum Cleaner and Engineering Co., Ltd.,** has take premises at 4, Bingley Hall Buildings, King Alfred's Place, Birmingham (telephone : Birmingham Midland 4806).

Tricorn Designs, Ltd., have moved to new offices at 141, Borough High Street, London Bridge, S.E.1 (telephone : Hop 5351/2).

Apprentice's Re-instatement

An Oswestry electrical apprentice, David Bennion, successfully applied to a Birmingham tribunal this week for re-instatement with his former employers, after his national service in the R.A.F.

Mrs. L. M. Crossley, secretary to his employers, W. H. Farrar, Ltd., said in evidence that Bennion could not be taken back because there was not enough work to keep him busy. She agreed, however, that his decision to go into the Forces in August, 1950, rather than stay with the firm under deferment, had caused some feeling.

Bennion said he joined the firm as an electrical apprentice, but had to break the contract when his father fell ill in 1948. He rejoined them in 1949, under what he thought was an apprenticeship agreement. The company was ordered to re-employ Bennion at an agreed union rate, and to give him five weeks' back pay from the date of his first application.

New Walsall Conduits Branch

Walsall Conduits, Ltd., opened a further sales and service branch at Grosvenor House, St. Catherine's Grove, Lincoln, on 5th July—the 34th of its kind in the British Isles. After the official opening by Mrs. A. E. Millard (wife of the managing director) a number of business friends and representatives from North Lincolnshire firms were entertained. The new branch is under the supervision of the North East Midlands area manager, Mr. F. N. Crabtree, who also controls the Nottingham and Sheffield depots.

Catalogues and Lists

Austin Taylor Electrical, Ltd., Ellesmere Street, Failsworth, Manchester.—Illustrated folder dealing with terminal boxes incorporating the new A.T.L. terminal block.

Automatic Telephone & Electric Co., Ltd., Strowger Works, Liverpool, 7.—A 46-page illustrated booklet giving an outline of the industrial resources and commercial activities of the company (1086/1).

Hackbridge & Hewittic Electric Co., Ltd., Walton-on-Thames, Surrey.—Illustrated folders on Hackbridge current limiting reactors (DB.18/1) and Hewittic mercury vapour lamps for photographic copying (CH.1).

Simplex Electric Co., Ltd., Creda Works, Blythe Bridge, Staffs.—Illustrated catalogue dealing with "Creda" water heaters and immersion heaters and folder on ironclad distribution boards.

Information Department

THE extensive records of our Information Department enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the makers of the following:—

"A.F.O." flush mounting press button switch starters 380 V 10 A 3 phase (German or Dutch ?)

General inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by the Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

ELECTRICITY SUPPLY

One Scottish Board ?

Birmingham "Prefab" Installations

ACCORDING to the political correspondent of the *Scotsman*, the Secretary of State for Scotland (Mr. James Stuart) told a deputation of Scottish Unionist M.P.s last week that next session there was a definite prospect of a Scottish Electricity Bill to enact the Unionist policy of amalgamating the three present Scottish Electricity Boards. The correspondent adds that it is understood that the Government plan will give the new all-Scotland Board independent authority, its reports being submitted to Parliament through the Secretary of State for Scotland.

Irish Electricity Programme

The Irish Electricity Supply Board has announced its plans for an increased output of electricity in Ireland. Their implementation is expected to take about five years and to cost £22 million. By 1957, more than 371,000 kW, which is some 120,000 kW more than the total capacity at the moment, will have been installed —or an overall output increase of 248 per cent, 33 per cent of which will come from three new peat-fired generating stations. Other new stations will include two hydro-electric stations, one oil-fired station, and two fired by coal or oil.

The completion of this scheme will mean the virtual exhaustion of Ireland's available hydro-electric resources. The E.S.B., however, expects to be able to report shortly on the possibility of harnessing the wind for the generation of electricity. Irish engineers are conducting experiments of this kind simultaneously with electrical engineers of Great Britain, America, Holland, Norway, Sweden and France.

Fire Danger in "Prefabs"

Following two serious fires in prefabricated houses last year the Birmingham Corporation Housing Committee instituted an inspection of the electrical installations which has revealed that many tenants are creating a fire risk by making their own additions to the installations.

Mr. S. Dagnall, electrical contractor, who is carrying out the inspection for the Corporation, stated in an interview with the *Birmingham Gazette* that so far all the original installations have been found to be perfectly safe. The trouble has arisen through people making their own additions to the wiring, using appliances of a heavier loading than the houses are wired to carry, and putting in fuse wire of too high a rating. Many tenants have been found to be using unearthed irons and fires. Mention is also made of the danger arising from the extension of wall-bracket lighting circuits to the centre of the ceiling by means of a piece of flex held in place by staples.

Tenants are warned in their rent books not to install additional wiring without the Housing Department's consent and not to use appliances rated at more than 1 kW.

Tax on Domestic Appliances

The North Western Electricity Consultative Council has passed a resolution urging the Electricity Board to press the Government for the revision or abolition of purchase tax on electrical appliances, or at least on those used in off-peak periods.

Services in Council Houses

Dudley Town Council has been recommended by its Housing Committee to continue the practice of installing gas cookers in Council houses, but with electric points so that tenants who wish to provide electric cookers at their own expense may do so. In a letter from the district manager of the Midlands Electricity Board it was pointed out that the Board was seriously concerned because the revenue from the new houses bore no satisfactory relationship to the very considerable capital expenditure necessary to provide substations, mains and services. Area Boards, it stated, were permitted to ask local authorities to contribute to such costs, but so far the Midlands Board had refrained from doing so in Dudley. The Board much preferred to discuss ways of improving possible revenue, one of which would be for the kitchens to be wired and the circuits sealed off until required.

Rationing in Melbourne

Continuously since early in 1949 and intermittently in the three preceding years electricity consumption in Melbourne has been restricted because of the fuel and plant shortage in the State. We learn from the latest report of the city electrical engineer (Mr. B. Woodfull) that the year 1950–51 saw no improvement; in fact, it became necessary to introduce a "quota" system whereby consumers were limited to a proportion of the previous year's consumption.

In consequence, the Department's sales, which had continued to rise in spite of previous restrictions, declined by 1·2 per cent to 211·5 million kWh. Actually, in the six months of the financial year to 30th September, 1951, during which the quota system operated sales fell by 6·5 per cent and the maximum demand is estimated to have been cut by 16,000 kW. Higher charges maintained the financial position of the undertaking, the year's trading producing a net surplus of £28,149. There was no building development in the city during the year.

Water Heaters for Schools

West Bromwich Corporation has approved a scheme for the installation of electric water heaters in schools in the borough at a total estimated cost of £4,000.

Uganda Transmission Line

The construction of a transmission line from Owen Falls to the Kilembe Mines, is proposed at an estimated cost of £2 million. Discussions on the basis of a substantial contribution by the mining company to the Uganda Electricity Board, together with an annual payment for 11,000 kW of power, have recently been concluded in Canada between representatives of the Kilembe Mines, Ltd., Mr. C. C. Spencer, Financial Secretary, Uganda, and Mr. C. R. Westlake, chairman of the Uganda Electricity Board.

Indian Electricity Output

During the first quarter of 1952 a total of 1,463 million kWh was generated and purchased by public utilities in the Indian Union. This compares with 1,385 million kWh in the corresponding period of last year. Sales (million kWh) totalled 1,194 (against 1,107), including industrial power, 766 (711); domestic, 141 (132); commercial light and small power, 83 (76); and irrigation, 61 (46).

I.O.M. Charges Raised

With effect from the next meter readings, the present surcharge of 10 per cent on domestic tariffs in the area of the Isle of Man Electricity Board is to be increased to 25 per cent.

Dutch Railway Electrification

The *Railway Gazette* reports the inauguration of electric traction on the Zwolle–Leeuwarden and Meppel–Groningen sections of the Netherlands Railways.

Television Relay

The Seaton Valley Relay Co. has begun work on the foundations of a 120ft steel television aerial intended to supply wired television throughout the area. It will provide a service to about 8,000 houses and is the first project of its kind in the North East. The company believes that the aerial will be capable of receiving clear signals from Holme Moss or Kirk o'Shotts.

New Bombay Thermal Station

Indian Trade and Engineering reports that the Government of Bombay has decided to entrust the construction of a new 100,000 kW thermal power station on Trombay island, eight miles from Bombay, to the Tata concern.

Norwegian Power Levy

Contending that it is contrary to the principles of the Constitution that a levy for general community purposes should be applied so as to place a heavy burden on a particular group of taxpayers, a Norwegian hydro-electric company has brought a test case against a special Government tax on the production of the larger power concerns. This levy is intended to be used as a contribution towards expenditure on extending electricity supplies to areas not yet served.

Maintenance of Domestic Services

One of the interesting features of the annual report of the Liverpool Corporation Housing Committee is a comparison of the cost of repairs and maintenance of electrical services in permanent houses, as against that of temporary houses. In 1951/2, the cost in permanent houses was £8,132, representing an average of 3s 2d per house (1950/1, £7,729, or 3s 2d per house); temporary houses, 1951/2, £5,258, an average of 30s per house (1950/1, £5,258, representing an average of 33s 2d).

Coronation Celebrations

PRELIMINARY plans for the Coronation celebrations next June were outlined last Friday by Mr. David Eccles, Minister of Works. Mr. Eccles said that they were preparing schemes of floodlighting of Government buildings and of lighting along the route and he hoped that owners of other prominent buildings in London and outside would make similar arrangements. The Ministry of Works was being asked to give a lead in suggesting schemes but he thought that variety was desirable and that it was better to have individual displays. He appealed to all to plan well ahead and make the best of a glorious occasion. In reply to a suggestion that he should approach the Electricity Boards to supply electricity for floodlighting at special rates, Mr. Eccles pointed out that the main cost of illuminations was in the equipment not in the electricity consumed.

While a wide range of Coronation emblems, etc., have been exempted from purchase tax for twelve months, the Commissioners for Customs and Excise announce that the exemption does not apply to any electric lamps or tubes supplied with them.

FINANCIAL SECTION

Company Notes and Stock Exchange Activities

Reports and Dividends

General Electric Co., Ltd.—At an extraordinary meeting to follow the annual general meeting on 25th September the ordinary stockholders are to be asked to pass a resolution for capitalizing £5,877,720 of the £7,027,190 standing to the credit of the share premium account. This would be issued to the ordinary stockholders in the form of £1 ordinary shares in the proportion of one new share for each £1 of stock held. The new shares would not rank for the final dividend in respect of the year ended 31st March, 1952, but for subsequent dividends. Upon issue the new shares would be converted into ordinary stock.

To provide for this issue and to make further shares available for future issue if and when required, the directors recommend an increase in the authorized capital by the creation of 12,000,000 ordinary shares of £1 each.

Further resolutions will be proposed at this meeting and at meetings of the preference stockholders to meet the alterations in the latter's rights involved in the new issue.

The directors' report upon the past year states that the satisfactory results have been due to a considerable expansion of turnover in many of the company's products, both at home and abroad, in spite of raw material and labour shortages. The year ended with a record in production and a record order book. The demand for the company's wide range of capital goods continued undiminished throughout the year but there has been a continuing fall in orders for consumer goods. Exports have created a new record and the overseas companies had a successful year. At 31st March last employees numbered about 64,000.

Thomas de la Rue & Co., Ltd.—In his speech at the annual meeting on 30th July the chairman (Mr. B. C. Westall) said that additional permanent working capital was needed and the board was giving serious consideration to the amount required and the form which the new capital should take. Shareholders would be informed of the decision in due course.

Hick, Hargreaves & Co., Ltd.—Speaking at the annual meeting on 30th July, Mr. W. d'Arcy Madden (chairman) said that the works had continued in full production during the past year and they had a heavy order book, the larger part of which comprised work of the highest priority for the British Electricity Authority and the Ministry of Supply. He had made valuable contacts during a visit to South Africa earlier in the year and the company had secured an important order for condensing plant for the Kelvin station of the Johannesburg City Council. Extensions to the works would commence shortly.

The Electric Construction Co., Ltd., shows an increase from £506,773 to £535,884 in the consolidated gross profits for the year ended 31st March, the combined net profit rising from £222,069 to £233,155. Taxation absorbed £140,330 (£125,839) and £50,000 (£60,000) was allocated to various reserves, a sum of £89,373 (£97,369) being transferred to the appropriation account of the parent company. After paying an ordinary dividend of 15 per cent (same), £60,805 (£52,252) is carried forward. Mr. W. M. Furniss, chairman and managing director, speaking at the annual general meeting, said that factory extensions nearing completion were planned to deal more efficiently with the continually increasing demand for the company's products. Partly to finance the building and equipping of these new extensions an issue of ordinary shares is being made. They were considering making certain products in South Africa and Australia.

Johnson Matthey & Co., Ltd., report a net profit for the year ended 31st March, after taxation, of £404,114, compared with £399,998 in the preceding year. A contribution of £104,114 (nil) is made to the superannuation fund and it is proposed to pay a final dividend of 12 per cent (same), again making a total distribution of 15 per cent. The carry-forward is increased from £1,027,591 to £1,237,342.

Parmiter, Hope & Sugden, Ltd., have declared a final dividend of 17½ per cent on capital increased by 40 per cent making a total for the year of 25 per cent (against 30 per cent). The net profit for the year was £38,228 (against £41,955). General reserve receives £5,820 (against £25,000); goodwill patents and trade marks are eliminated by writing off £52,600; and £23,793 (against £63,538) is carried forward.

Cable & Wireless, Ltd.—The annual report and accounts for the year ended 31st March, published as a White Paper, show that, before appropriations for taxation and dividend, there was a surplus of £1,481,649, compared with £2,232,743 in the previous year.

Provision for future and deferred taxation requires £1,016,989 (£1,399,403), leaving £464,660, which is insufficient to meet the customary dividend of 4 per cent. After therefore paying a dividend of 2½ per cent, £973,273 (£902,363) is carried forward.

Belliss & Morcom, Ltd., are maintaining the year's distribution at 12½ per cent by a final dividend of 8½ per cent. It is also proposed to pay a centenary bonus of 2½ per cent, free of tax, from profits on investments out of the contingencies reserve. The group profit, after taxation, rose from £52,836 to £80,059 and there was a profit of £124,117 on sale of investments. A sum of £100,000 (against nil) is put to general reserve and £25,000 (nil) to contingencies reserve; £60,833 (against £30,566) is carried forward.

The Mirrlees Watson Co., Ltd.—Speaking at the annual meeting on 31st July, Mr. D. M. Semple (chairman and managing director) said that during the past year the company had received orders for condensing and feed-heating plant from the British Electricity Authority, the National Coal Board and various iron and steel works in this country, and for several condensing plants from Australia. There was a large demand for small turbines for industrial purposes while the wide variety of steam conditions had thrown a heavy load on the company's design department. Orders for a large number of pumps had included units for power stations.

Scottish Cables, Ltd.—This company has obtained Treasury consent to the proposed issue to ordinary stockholders of a scrip bonus of one new ordinary share for each existing 4s stock unit. The directors recommend that the share premium account of £206,772 should be used towards paying up the new shares and that the balance should be provided as to £21,240 out of E.P.T. post-war refund and as to £63,655 out of general reserve. The 1,458,335 new ordinary shares will be converted into £291,667 ordinary stock transferable in multiples of 4s and will rank for any dividend to be declared in respect of any period subsequent to 30th April, 1952, and in all other respects *pari passu* with the existing issued £291,667 ordinary stock.

Oldham & Son, Ltd., have received the consent of the Capital Issues Committee to the issue of 4,000,000 fully-paid 1s ordinary shares by capitalizing £200,000 of the reserves. The distribution will be in the ratio of one new share for each ordinary share held on 16th August.

Receiver Released

Victor Battery Co., Ltd.—G. R. Lowe, 91, Park Street, Park Lane, W.I, ceased to act as receiver and manager on 17th June.

Liquidations

Electrical Engineering and Advice Bureau, Ltd., electrical contractors, 27, Regent Street, London, W.1.—First and final dividend of 8½d in the £, payable at the office of the Official Receiver and Liquidator, Inveresk House, 346, Strand, London, W.C.2.

Crown Lane Radio, Ltd.—Winding up voluntarily. Liquidator, Mr. D. Morgan, 100, Park Street, London, W.1, appointed 22nd July.

Barwell Electrical Products, Ltd., Wandsworth, London, S.W.18.—Liquidator, Mr. H. P. Naunton, Official Receiver and Liquidator, Inveresk House, 346, Strand, London, W.C.2, released 14th July.

Bankruptcies

K. G. Rudd, radio and electrical contractor, 4, Commercial Road, and formerly 52, Eastgate, Louth.—Receiving order made 25th July on debtor's own petition.

K. J. Ward, electrical contractor, lately carrying on business at "Howard," Trusthorpe Road, Sutton-on-Sea, Lincs.—Receiving order made 23rd July on debtor's own petition.

Kirkstall Radio & Electrical Service, radio and electrical engineers, Kirkstall Lodge, Edwinstowe, Notts. — First meeting held 6th August at the Official Receiver's Office, 22, Regent Street, Park Row, Nottingham. Public examination, 6th November, at the County Court House, St. Peter's Gate, Nottingham.

D. G. Edwards, electrical engineer, 8, Blackfriars Road, Newcastle-under-Lyme.—Public examination, 11th September, at the Town Hall, Hanley, Stoke-on-Trent.

H. L. Ruff, electrical engineer, 141, Abbeydale Road, Sheffield.—Proofs for dividends by 13th August to the trustee, Mr. A. L. Medcalf, Official Receiver, 55, Queen Street, Sheffield, 1.

G. A. Phipps, 51, Frampton Crescent, Fishponds, Bristol, electrician.—First meeting 14th August at the Official Receiver's Office, 26, Baldwin Street, Bristol. Public examination 10th October at the Guildhall, Small Street, Bristol.

J. R. L. Allen, lately carrying on business as "Vision Radio Services" at 7, Balham Station Road, London, S.W.12, radio dealer and engineer.—Trustee, Mr. A. W. Hunter, 418-422, Strand, London, W.C.2, released 23rd April.

F. H. Pountney, trading as "Bordesley Electrical Co.", 164, High Street, Bordesley, Birmingham, electrical engineer.—Supplemental dividend of 3s 1½d in the £ payable 15th August at the Official Receiver's Office, Somerset House, 37, Temple Street, Birmingham, 2.

STOCKS and SHARES

So far as investment securities were concerned, last week's economic debate in Parliament passed off without making much difference to the situation and outlook. In most markets, prices quickly recovered such declines as had occurred previously in anticipation of the event. Sensitive as ever to any decisions which might affect the Bank Rate, the gilt-edged market registered relief over the fact that the subject was barely mentioned. Industrials followed this lead, so that, on the eve of the Bank Holiday, markets as a whole looked firm, although so inactive as to deprive price movements of any great significance. In the industrial market, most attention was claimed by the engineering groups, on the view that these emerged best from what Government spokesmen had to say about their plans. Electrical equipment shares were marked up generally. Few of the changes were outstanding; Siemens and Telegraph Construction new shares were noticeably good during the last few days in which they could be bought in allotment letter form.

Electric Construction Meeting

The Electric Construction Company's £1 ordinary shares, quoted at about 43s 6d, show a yield of not much under 7 per cent on the 15 per cent dividend, which is shown by the latest accounts to be again well within the group's earning capacity. At last week's annual meeting, the chairman's account of the results and prospects had much in common with the G.E.C. report published on the same day. After checks to progress in the first part of the year due to raw material shortages, turnover, as well as the order book, reached record proportions, and the factory is working at full capacity. Factory extensions have been undertaken, and new capital is required to finance them. Net profit for the year, after higher taxation, came out at £90,000, or a little under the previous figure. About one-third of the surplus is being paid in dividends, the balance being added to an already strong reserve position.

G.E.C. Accounts

The General Electric Company's proposal of a 100 per cent share bonus will come up for approval after the annual meeting on 25th September. The impression remains that the operation is not likely to be a factor affecting dividend policy, but that, in doubling the number of shares in issue, and in presumably halving their price, it should enhance their marketability and their appeal to the smaller investor. The full group accounts confirm that the year's net taxed profit of a little over £2 million covers the 22½ per cent ordinary dividend comfortably three times over. In the balance sheet, attention is drawn to the increase of more than £8 million under the heading of stocks and work in hand, the combined outcome of a higher volume of production and of the rise in raw material and labour costs. With nearly £6 million coming in as a result of last February's share issue, a strong cash position has been preserved. In his review accompanying the accounts, the chairman refers to records in production, in exports and in the order book. He makes it apparent that the main contribution came from the group's production of capital equipment, as opposed to consumer goods, for which orders everywhere are in a decline.

Parmiter, Hope & Sugden

This company's final dividend of 17½ per cent, for the year ended in March, makes a total of 25 per cent, all of which applies to ordinary capital increased since last year by a 40 per cent capital bonus. The distribution of 30 per cent for the previous period was equivalent to about 21½ per cent on the present capital, so that shareholders are again receiving a moderate increase. The payment this time takes about £19,000 net, against £16,000 previously, and comes from a net taxed profit of £38,000. Having been increased by an earlier capital bonus of 90 per cent, the present ordinary capital of £143,000 compares with an amount of £54,000 in issue shortly after the war. The 30 per cent dividend, then being paid, represented less than half the net amount of the latest distribution. Quoted at about 2s 3d, the 1s shares pay a little over 11 per cent on the money.

Hackbridge & Hewittic

The 5s ordinary shares of Hackbridge & Hewittic have been well supported since publication of the results for the year ended last March, and stood at 15s at the time when the annual meeting was held last week. In raising the latest ordinary dividend to a total of 20 per cent, the company maintained its record of having made a modest increase in the distribution for each year since the firm became public five years ago. Latest net profits of £159,000 represented earnings of about 58 per cent gross on the £500,000 ordinary capital. In his review circulated with the annual accounts, the chairman reported that orders on hand at the end of June were nearly £1½ million greater than was the case a year previously, and represented two-and-a-half years' output at the present rate of production: they largely concerned work for the rectifier division in this country and across the Atlantic. The shares stand on a yield basis of 6¾ per cent.

CANADIAN ELECTRICAL IMPORTS

Large Increase in 1951

IMPORTS of electrical goods into Canada in 1951 showed an increase in value of about 45 per cent on the preceding year; the total was $120,101,000. The advance ran through all the principal groups. The United Kingdom improved her position in a number of lines, but the United States remained the predominant supplier. Switzerland, Sweden, Germany and Japan were also competitors. The accompanying tables give the totals of the principal groups of goods and apparatus and electrical machinery and the supplying countries, together with notes of increases or decreases (which were few) compared with 1950.

Goods and Apparatus	1951 $ (000)	Inc. or dec. on 1950 $ (000)
Batteries, flashlight and parts	142	+ 131
Batteries, hearing aid, and parts	341	+ 56
Batteries, primary, n.o.p.	493	+ 299
Batteries, storage	764	+ 86
From United Kingdom	90	+ 30
„ *United States*	674	+ 56
Torchlights, flashlights, side and tail lights	1,040	+ 314
From United Kingdom	93	+ 21
„ *United States*	625	+ 202
„ *Germany*	22	+ 19
Lighting fixtures and appliances	4,929	+ 1,226
From United Kingdom	87	+ 36
„ *Germany*	40	+ 23
„ *United States*	4,531	+ 1,171
„ *Japan*	48	+ 3
Electricity meters	1,689	+ 719
From United Kingdom	148	+ 74
„ *United States*	1,510	+ 625
„ *Switzerland*	30	+ 19
Rheostats, controllers, etc.	8,181	+ 1,969
From United Kingdom	195	+ 52
„ *United States*	7,913	+ 1,909
„ *Switzerland*	73	+ 9
Electric irons	253	— 30
From United Kingdom	80	— 41
„ *United States*	173	+ 11
Telegraph apparatus	1,823	+ 487
From United Kingdom	81	+ 54
„ *United States*	1,740	+ 431
Radio valves	3,352	+ 1,699
From United Kingdom	25	— 14
„ *United States*	3,310	+ 1,717
Radio receiving sets	593	+ 329
From United Kingdom	32	— 16
„ *United States*	560	+ 354
Other radio apparatus, n.o.p.	17,416	+ 3,807
From United Kingdom	1,579	+ 422
„ *United States*	15,837	+ 3,385
Telephone apparatus	8,207	+ 1,302
From United Kingdom	1,547	— 474
„ *United States*	6,655	+ 1,773
Electric dry shavers	1,227	+ 2
From United States	1,201	+ 40
„ *United Kingdom*	8	— 13
Electrical precision instruments	2,563	+ 603
From United Kingdom	144	— 53
„ *United States*	2,414	+ 654
Electrical apparatus, n.o.p.	13,552	+ 4,074

Electrical Machinery	1951 $ (000)	Inc. or dec. on 1950 $ (000)
Elec. steam generators and parts of a kind not made in Canada	6,837	+ 3,821
From United Kingdom	6,352	+ 4,193
„ *Switzerland*	317	+ 302
Dynamos and parts	6,735	+ 3,135
From United Kingdom	316	— 65
„ *United States*	6,388	+ 3,196
„ *Switzerland*	12	+ 11
„ *Germany*	10	— 10
Motors valued at less than $10	749	+ 53
From United Kingdom	109	+ 52
„ *United States*	626	— 13
Motors, other, and complete parts	15,859	+ 5,176
From Germany	20	+ 17
„ *United Kingdom*	1,543	+ 542
„ *Sweden*	70	+ 1
„ *United States*	14,126	+ 4,872
„ *Switzerland*	17	+ 11
Transformers and parts	2,750	+ 625
From United Kingdom	731	+ 238
„ *United States*	1,975	+ 397
„ *Switzerland*	32	— 22
Switchgear for use in coalmines	288	+ 219
From United Kingdom	112	+ 64
„ *United States*	176	+ 155
Switches, switchboards, etc.	8,351	+ 2,576
From United Kingdom	470	+ 141
„ *United States*	7,677	+ 2,745
„ *Switzerland*	196	— 318

During the first quarter of 1952 Canadian imports of electrical equipment amounted to $31,055,000, an increase of 12½ per cent on the corresponding period of 1951.

Appliance Approval in Australia

IN June new regulations were put into force in New South Wales governing the approval of electrical appliances and fittings. *Erda* (Sydney) says that the object is to bring the State's requirements into line with those of other States. The regulations also provide that in future individual types or models of a particular appliance will have to be approved. Formerly all models in a range of, say, electric irons were given "omnibus" approval. The appliances covered by the regulations are toasters, grillers, radiators, portable immersion heaters, plugs and sockets, wall switches, soldering irons, appliance connectors, kettles, saucepans, jugs, irons, adaptors, cord extension sockets, razors, miniature overcurrent circuit breakers, earth leakage circuit breakers, hand lamps, cord line switches and portable electric cookers.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 17th September from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1946

11225. Marconi's Wireless Telegraph Co., Ltd.—Cathode beam tubes and operating circuits therefor. 11th April, 1946. (679258.)

1947

19971. Philips Lamps, Ltd.—Methods of applying a thin covering layer to a substratum. 24th July, 1947. (679532.)

20758. Battelle Development Corporation.—Apparatus for producing photographs electrically. 31st July, 1947. (679533.)

29311. Hazeltine Corporation.—Electromagnetic wave energy absorbing material. 3rd November, 1947. (679259.)

30460. Radio-Industrie Soc. Anon.—Communication systems between two stations linked by television. 17th November, 1947. (679167.)

32768. Parsons & Co., Ltd., C. A., Bowden, A. T., Hryniszak, W., and Kolb, P.—Rotary regenerative heat exchangers. 12th January, 1949. (679168.)

32774. Parsons & Co., Ltd., C. A., and Bowden, A. T.—Sealing devices for heat exchangers of the rotary regenerative type. 12th January, 1949. (679169.)

32985. Sherman, R.—Restoration and maintenance of conductivity in electrical systems. 15th December, 1947. (Cognate application 32986, 31st December, 1946.) (679468.)

1948

18011. Standard Telephones & Cables, Ltd., and Mayer, S. E.—Manufacture of thin metal laminæ. 1st July, 1949. (679174.)

20044. Aerovox Corporation.—Electrostatic capacitors. 27th July, 1948. (679539.)

22915. Philips Electrical, Ltd.—Discharge tubes for use in frequency demodulation. 31st August, 1948. (679176.)

30411. Telefonaktiebolaget L. M. Ericsson.—Electron discharge tube for amplifying micro-waves. 23rd November, 1948. (679471.)

1949

656. British Thomson-Houston Co., Ltd.—Reversible thermostatic valve systems. 10th January, 1949. (679181.)

3039. Mercer, R.—Telecommunication systems. 1st February, 1950. (679544.)

5221. British Thomson-Houston Co., Ltd., and Rees, M. W. T.—Dynamo-electric machines. 27th January, 1950. (679474.)

5349. Young, I. F., and Clements, V. A. H.—Automatic electrical demand limiter. 19th March, 1951. (679341.)

5583. Warner, A. R., and Ward, D. A.—Electric oscillation generators. 1st March, 1950. (679368.)

12077. Eastell, E. L.—Portable battery energized electric lamp equipment. 1st May, 1950. (679186.)

12857. General Electric Co., Ltd., and Ryeroft, J. L.—Electric hotplates. 15th May, 1950. (679188.)

13571. Gillott Electro Steam Cookers, Ltd.—Thermally-operated releasable electrical cut-outs. 22nd May, 1950. (679476.)

14258. General Electric Co., Ltd., and Turrall, J. C.—Diesel-electric generating sets. 25th May, 1950. (679477.)

15140. Patelhold Patentverwertungs & Elektro-Holding Akt.-Ges.—Radio apparatus for producing electric waves for correcting the deviations of automatically controlled flying objects from a preselected path. 7th June, 1949. (679189.)

15868. Staatsbedrijf der Posterijen, Telegrafie en Telefonie.—Valve circuit arrangement for producing an output voltage which varies a plurality of times during the period of variation of an input voltage. 14th June, 1949. (679371.)

18440. Adie, K. S.—Illuminant enclosures. 11th July, 1950. (679548.)

20230. General Electric Co., Ltd., and Sawter, A. B.—Cold pressure welding. 28th July, 1950. (Cognate applications 4591, 22nd February, 1950, and 12928, 23rd May, 1950.) (679195.)

20281. Electric & Musical Industries, Ltd.—Sawtooth waveform generators. 17th July, 1950. (679550.)

20895. Canning & Co., Ltd., W. (Weisberg, L.).—Electrolytic solutions for the electro-deposition of metals. 11th August, 1949. Convention date not granted. (679551.)

26262. Electric & Musical Industries, Ltd.—Cathode-ray tubes. 26th September, 1950. (679201.)

26855. British Thomson-Houston Co., Ltd.—Methods of decreasing the adhesion of ice to various surfaces. 19th October, 1949. (679559.)

27683. Jackson Bros. (London), Ltd., and Reid, J. P.—Variable manually operated controls, particularly for television receivers. 20th October, 1950. (679377.)

28104. Bendix Aviation Corporation.—Electrical control circuit. 2nd November, 1949. (679560.)

29745. General Electric Co., Ltd.—Multi-channel pulse signalling systems. 24th November, 1950. (679267.)

31338. National Research Development Corporation.—Electric commutators and dynamo-electric machines employing commutators. 28th November, 1950. (679492.)

31691. General Electric Co., Ltd., and Winstanley, F.—Electric lighting fittings. 11th December, 1950. (679270.)

32353. Pye, Ltd., Weighton, D., and Sax, I.—Circuit for adjusting amplitude distortion. 12th December, 1950. (679495.)

1950

1564. Standard Telephones & Cables, Ltd.—Piezo-electric crystal plates. 19th January, 1951. (679575.)

2440. Austin Crompton Parkinson Electric Vehicles, Ltd., and Jones, C. E.—Motor road vehicles. 31st January, 1951. (679214.)

3550. Lucas, Ltd., J.—Protective means for electricity storage battery cases. 8th February, 1951. (679501.)

4028. Soc. d'Electronique et d'Automatisme.—Electric signalling systems for coded trains of impulses. 16th February, 1950. (679390.)

4778. English Electric Co., Ltd.—Control of dynamo-electric machines. 23rd February, 1951. (679392.)

5343. Compagnie pour la Fabrication de Compteurs et Matériel d'Usines à Gaz.—Television transmission systems. 2nd March, 1950. (679393.)

6929. Metropolitan-Vickers Electrical Co., Ltd.—Electric circuit arrangements for measuring radio frequency power. 1st January, 1951. (679505.)

7427. Mullard Radio Valve Co., Ltd.—Electric-discharge tubes. 3rd May, 1951. (679506.)

7639. British Insulated Callender's Cables, Ltd.—Manufacture of electric cables. 19th June, 1951. (679218.)

8764. Philips Electrical Industries, Ltd.—Electric incandescent lamps and fittings therefor. 6th April, 1950. (679219.)

9396. Neck, C. G.—Strain clamp and jointing clamp fittings for electric conductors. 17th April, 1950. (679221.)

9498. General Electric Co., Ltd., Butcher, C. H., and Widdowson, A. E.—Electrical elements of non-inductive form and apparatus for manufacturing the same. 18th April, 1951. (679582.)

9959. Record Electrical Co., Ltd., and Abbink-Spaink, P. F.—Electrical testing equipment. 2nd April, 1951. (679511.)

11850. Electromagnets, Ltd., Box, W. E., Claridge, J. T., and Turnock, A. G.—Magnetic separators. 18th October, 1950. (679277.)

12102. Grassmann, W.—Methods and apparatus for the separation of mixtures of substances by electrophoresis or electrolysis. 15th May, 1950. (679278.)

13175. Young Accumulator Co., Ltd.—Manufacture of electric battery separators. 25th May, 1951. (679514.)

13333. Communications Patents, Ltd.—Method of and apparatus for welding electrically thermoplastic sheet material. 26th May, 1950. (679283.)

14436. Woolfson, J., and Woolfson, E. (trading as Scottish Precision Engineering Co.), and Mosley, W.—Electric irons. 11th June, 1951. (679289.)

14788. Soc. Anon. de Télécommunications.—Device for the measurement of the value of the time auto-correlation function of the voltage developed across an electrical impedance. 13th June, 1950. (679408.)

15114. Telefonaktiebolaget L. M. Ericsson.—Devices for connecting calls to certain subscribers' lines to operators' positions in automatic telephone exchanges. 16th June, 1950. (679517.)

15125. Nagard, Ltd.—Electrical time-base circuits and the like. 31st January, 1951. (679294.)

15437. Etablissements P. Duclos.—Cable-feed mechanism for cable ships. 20th June, 1950. (679298.)

16034. Igranic Electric Co., Ltd.—Free tripping overload electric switches. 27th June, 1950. (679232.)

16437. Belling & Lee, Ltd.—Electric cable end connectors. 30th June, 1950. (679410.)

16766. Schleisner-Petersen, E.—Change-speed device for electric motor drive of laundry machines. 5th July, 1950. (679412.)

16834. Metro-Cutanit, Ltd.—Magnetic material with good electrical conductivity. 5th July, 1950. (679413.)

17819. Pyrotenax, Ltd.—Electric cables or other insulated electric conductors. 29th June, 1951. (679234.)

19333. General Electric Co., Ltd., Cornell, W., and Harrison, W. J. D.—Mounting devices for telephone switches. 20th June, 1951. (679321.)

19756. Marconi's Wireless Telegraph Co., Ltd.—Thermionic valve amplifiers. 8th August, 1950. (679239.)

20053. Radio Corporation of America.—Amplitude modulation of radio-frequency carrier waves. 11th August, 1950. (679417.)

22062. Hackbridge & Hewittic Electric Co., Ltd., and Bingley, P.—Overload tripping or warning devices for electrical converting apparatus. 1st June, 1951. (679422.)

22856. Standard Telephones & Cables, Ltd.—Gain control networks for electric wave amplifiers. 18th September, 1950. (679424.)

23009. Metropolitan-Vickers Electrical Co., Ltd.—Electric transformers and like apparatus. 8th June, 1951. (679241.)

23368. Brooke, W., and Baldwin, H. T.—Remote control and protection of electric motors. 23rd September, 1950. Addition to 669607. (679524.)

23736. Bonadio, G. A.—Control electrodes for electronic valves. 28th September, 1950. (679428.)

27417. British Thomson-Houston Co., Ltd.—Dielectric materials. 9th November, 1950. (679330.)

28164. Oak Mfg. Co.—Turret type high-frequency tuners. 17th November, 1950. (679331.)

28798. Oak Mfg. Co.—Electrical tuning apparatus. 24th November, 1950. (679242.)

29081. Philips Electrical Industries, Ltd.—Telephony selector switch. 28th November, 1950. (679332.)

29222. Western Electric Co., Inc.—Electric glow discharge devices. 29th November, 1950. (679333.)

29253. Lumalampan Aktiebolag.—Luminescent electric discharge lamp. 29th November, 1950. (679432.)

29990. British Thomson-Houston Co., Ltd.—Elastic-fluid turbines. 7th December, 1950. (679335.)

30778. British Thomson-Houston Co., Ltd.—Locomotive power systems for supplying direct current traction motors from a single-phase alternating current source. 18th December, 1950. (679438.)

1951

2038. Welwyn Electrical Laboratories, Ltd., and Whitfield, E. H.—Mountings for tubular objects. 26th January, 1951. (679337.)

2201. General Control Co.—Electrical timer. 29th January, 1951. (679596.)

2646. Philips Electrical Industries, Ltd.—Circuit arrangements for use in automatic signalling systems. 2nd February, 1951. (679447.)

5259. British Thomson-Houston Co., Ltd.—Heat transfer apparatus. 5th March, 1951. (679450.)

8016. Gilbert & Barker Manufacturing Co.—Vibratory electric motor. 6th April, 1951. (679606.)

8036. Standard Telephones & Cables, Ltd. (Lorenz Akt.-Ges., C.).—Circuit for receivers for both AM and FM-VHF broadcasts. 6th April, 1951. (679343.)

8178. Philips Electrical Industries, Ltd.—High-vacuum molecular pumps. 9th April, 1951. (679607.)

9056. Rauland Corporation.—Cathode-ray tubes. 18th April, 1951. (679348.)

11128. Fairweather, W. C. (Singer Manufacturing Co.).—Clutch-brake mechanism for an electric drive. 11th May, 1951. (679355.)

11141. Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz.—Target electrodes for use in television camera tubes and storage tubes. 11th May, 1951. (679609.)

11452. Industriaktiebolaget Luxor.—Electric motors provided with speed governors. 16th May, 1951. (679454.)

12043. Allmanna Svenska Elektriska Aktiebolag.—Electric condensers. 23rd May, 1951. (679455.)

12607. Siemens & Halske Akt.-Ges.—Processes for the production of electrical apparatus of high insulation resistance, especially electric condensers. 29th May, 1951. (679358.)

13337. Metropolitan-Vickers Electrical Co., Ltd.—Voltage regulators for electrostatic generators. 5th June, 1951. (679359.)

14522. British Thomson-Houston Co., Ltd.—Dies for planing metal wires. 19th June, 1951. (679254.)

14894. Philips Electrical Industries, Ltd.—Frequency stabilizing arrangements. 22nd June, 1951. (679457.)

Garcke's Manual

TWO additions which add to its usefulness are included in the new edition of "Garcke's Manual of Electricity Supply" (Vol. 49) published by the Electrical Press, Ltd., 23, Great Queen Street, London, W.C.2, price £3 17s 6d carriage paid. These are a topographical index to district offices and service centres of the fourteen Electricity Boards, and a new subsection which summarizes, with explanatory notes, standard tariffs introduced by the various Boards. There is a general survey of electricity supply progress during the year, details of the constitution of the British Electricity Authority and the Electricity Boards, a list of generating stations, showing plant capacity and operating data, a section covering manufacturing and allied companies, and a directory of executive personnel.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Edinburgh.—North of Scotland Hydro-Electric Board. Supply and erection of overhead lines in Killin district, Perthshire. (See this issue.)

South Africa.—JOHANNESBURG.—18th September. South African Railways. Three butt-welding machines. (C.R.E. 25987/52. Ten/4409.)*

Wiltshire.—13th September. County Education Committee. Electrical installation in new secondary modern school, Corsham. (See this issue.)

Yorkshire.—1st September. West Riding Health Committee. Electrical installation at the Beeches, Tadcaster. (See this issue.)

ORDERS PLACED

Attleborough (Norfolk). — East Anglian Regional Hospital Board. Recommended. Reorganization of electrical installations at Wayland Hospital, Attleborough (£1,712).—Norwich Electrical Co., Ltd.

Chester.—Corporation. Recommended. Rewiring of Victoria Road School (£745).—A. E. Cheshire.

Coventry.—Education Committee. Electrical installation work, Templars Infants' School (£462).—P. D. Brady.

Electrical installation work, Central College of Art and Technology (£6,167).—F. L. Flinn.

London. — BATTERSEA. — Works Committee. Electrical installation work at 203/217, Battersea Park Road (£1,234).—Iverson Electrical, Ltd.

Libraries Committee. Recommended. Fluorescent lighting fittings for Central Library (£629).—Thorn Electrical Industries, Ltd.

Highways Committee. Recommended. Steel lamp columns, lamp brackets, and horizontal burning mercury vapour lanterns for the improvement of the public lighting in York Road (£1,083).—G.E.C.

POPLAR.—Borough Council. Electrical installations in blocks 11 and 12 of flats being erected by Sir Robert McAlpine & Sons, Ltd., in the Abbott Road area (£7,082).—Iverson Electrical, Ltd.

Wisbech.—East Anglian Regional Hospital Board. Recommended. Electrical services in operating theatre at North Cambridgeshire Hospital, Wisbech (£1,377).—Ely Electrical Co., Ltd.

*Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Horse Guards Avenue, Whitehall, S.W.1 (Trafalgar 8855).

CONTRACTS IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Amblecote.—Block of 48 flats for U.D.C.; Mark Round & Sons, Ltd., Dudley.

Ashford (Kent).—School, Beaver Green (£55,000); Kent county architect, Springfield, Maidstone.

Ayr.—Catholic church (£25,000), Dalmilling estate; Cowie & Ferrie, architects, Wellington Square, The Sandgate, Ayr.

Backworth (Northumberland). — R.C. church; R. Burke, 10, Lambton Road, Newcastle-on-Tyne.

Barnard Castle.—Houses (40), Staindrop, for R.D.C.; Shepherd & Sons, Ltd., builders, Blue Bridge Lane, York.

Barnet.—Flats (24), Underhill, for U.D.C.; D. M. Thomas, 135a, High Street.

Bedlington.—Child welfare centre; county architect, County Hall, Newcastle-on-Tyne.

Bideford.—Houses (10), at Pyms Lane estate; borough surveyor, Municipal Buildings.

Birmingham.—Seven blocks of flats, Hawkesley Farm, Aston Hall and Hobmoor Road estates; flats at Ward End Hall (227), Shard End (210), and Aston Reservoir (216); shops and flats, Chestnut estate; dwellings (80) and six shops, Ladywood area, and slipper baths, Heath Street, Winson Green; H. J. Manzoni, city engineer.

Blackpool.—Factory for N. Gledhill & Co., Ltd.; Wm. Eaves & Co., Ltd., Vicarage Lane, Marton, Blackpool.

Bognor Regis.—Houses (154) at South Bersted; R. W. J. Hill, clerk to U.D.C., Town Hall.

Bracknell.—Primary school, Jock's Lane; Berkshire county architect, Wilton House, Parkside Road, Reading.

Brighouse.—Works extensions; Woodcock & Booth, Woodvale Brassworks.

Brighton.—Factory at Moulsecombe Way for New Welbeck, Ltd., and R. J. Adcock & Co., Ltd.; town clerk.

Flats (270), Hollingdean estate: Rice & Son, Ltd., Knight Bros. (Brighton), Ltd., and T. J. Braybon & Son, Ltd.

Six shops with flats above, College Place, and ten houses, Essex Street; town clerk.

Bristol.—Health clinic, St. Anne's; city architect.

Bromsgrove.—Houses (40) at Charford estate, for U.D.C.; Stanley J. Smith & Co., Ltd.

Broughton-in-Furness. — Adaptations at Kepplewray Residential Special School (£25,910); C. Townson, Dalton-in-Furness.

Cardiff.—Blocks of shops and flats on sites at Fishguard Road and Llangranog Road; city engineer, City Hall.

Carlisle.—Canteen for Carlisle Steam Laundry Co., Ltd.; Johnston & Wright, architects, Carlisle.

Croydon.—Science Wing at Old Palace School; Graham & Denis Crump, architects, 43, George Street.

Derby.—Twin operating theatres at Royal Infirmary; Sheffield Regional Hospital Board, Fulwood House, Old Fulwood Road, Sheffield.

Doncaster.—Sheet metal works, Marsh Gate; Higgins & Parkes, North Bridge Road.
Houses (28), Cantley estate; J. S. Pott, 6, Church Lane, Bessacarr.

Enfield.—Dwellings (36), Lyndhurst Gardens; U.D.C. surveyor, 7, Little Park Gardens.

Fleetwood.—Houses (24), Broadway; R. Fielding & Sons, Ltd., Blackpool. Houses (24) and two shops, Highbury Avenue and Hatfield Avenue; J. Cryer & Sons, Poulton Road, Fleetwood.

Glasgow.—Flats (495), Garthamlock area; city housing architect.

Gosforth.—Flats (126) for U.D.C.; R. Bowey & Son, Back Raby Street, Newcastle-on-Tyne.

Hemel Hempstead.—Foundry extensions; Hemel Hempstead Engineering Co., Ltd., Cupid's Green.

Hepton.—Houses (20), Boston Hill, Wadsworth; R.D.C. surveyor, District Bank Chambers, Hebden Bridge.

Heywood.—Works, Schofield Road; W. Rhodes, Ltd., Miller Street.

Houghton-le-Spring.—Children's home for Durham C.C.; county architect, Court Lane, Durham.

Hove.—Flats (72), St. Helens estate, for Housing Committee (£78,112); H. J. Paris, Ltd., builders, Church Road, Hove.

Ilkeston.—Houses (28), Kirk Hallam estate; Sherwin Building & Construction Co., Ltd., Ilkeston.

Jarrow-on-Tyne.—R.C. school at Alnwick Grove (£51,000); B. Peel, Ltd., builders, East Mill Works, North Shields.

Lancaster.—Dwellings (30), Westfield War Memorial Village; F. Prentice Mawson, architect, Lancaster.

Liverpool.—Rebuilding large office premises at 13/15, Harrington Street, for Temple Building Co., Ltd., Medcalf & Medcalf, architects, 3, Stanley Street, Liverpool.

Llandudno.—Flats (24), Tre Creuddyn estate; Frank Tyldesley, Victoria Street.

London.—PADDINGTON. — Flats (28), St. Philip's Place; C. Pitt & Son, Ltd., 1/2, The Studios, Blomfield Crescent, W.2.
POPLAR.—Dwellings (40), Bazeley Street and Tredegar Road; Rider, Hunt & Partners, surveyors, Bridge House, Queen Victoria Street, E.C.4.
STEPNEY.—Welfare centre and library building, Cable Street, E.1; borough surveyor, 227-233, Commercial Road, E.1.
WANDSWORTH.—Flats (144), in six blocks, Clapham Road, S.W.4; C. H. James, architect, 5, Bloomsbury Street, W.C.1.

Manchester.—Office block for Renold & Coventry Chain Co., Ltd.; J. Gerrard & Co., Ltd., Swinton, Manchester.

Newcastle-on-Tyne.—Second stage of Rutherford College of Technology scheme; R. H. Duns, quantity surveyor, Lambton House, Lambton Road, Jesmond, Newcastle.

Norham (Northumberland). — Houses (22) at Cornhill for the R.D.C.; Gray & Paterson, architects, 11, Castlegate, Berwick.

Northfleet.—Additional factory premises: Component Fittings, Ltd., 66, Victoria Street, S.W.1.

North Riding.—Infants' school at Eston for the C.C.; Coultas & Shaw, Ltd., builders, Stephenson Street, Thornaby-on-Tees.

North Shields.—Extensions to factory for the Fish Meal Oil Co.; H. W. Burton, Ltd., King Street, North Shields.

Nottingham. — Laboratory and depot at Meadow Lane for Trent River Board; W. H. Haile, engineer to the Board, 20, Barrack Lane, Nottingham.

Rochdale.—Nine blocks of flats at Ivor Street estate; B. Neodox, Ltd., Atlantic Chambers, Brazennose Street, Manchester.

Scarborough.—Houses (40) for Admiralty workers; H. V. Overfield, borough engineer.

Sheffield. — Houses, Hackenthorpe estate: J. W. Sivil, Ltd. (114), J. F. Finnegan & Co. (Sheffield), Ltd. (108 and 20 flats), W. Redmile & Sons, Ltd. (50), C. L. Marcroft, Ltd. (48 and 12 flats), F. Ridal & Sons (Ridal), Ltd. (42 and 12 flats), M. J. Gleeson (Contractors), Ltd. (102), W. L. Simpson, Ltd. (69), Redmile & Poole, Ltd. (76), Ackroyd & Abbott, Ltd. (54) and T. V. Simpson (50). All Sheffield firms.

Stafford.—Development of Tillington Hall site for houses, shops, etc.; T. H. Higson, borough surveyor, Mount Street.

Sunderland.—Houses for the T.C. Builders: L. V. Evans, Ltd., Sunderland (132); G. Henderson, East Boldon (58); Clerey & Son, Sunderland (63); Gibbons & Son, Sunderland (54); G. Bell, Sunderland (54); and Stewart Brothers, Sunderland (26).

Swansea.—Production engineering laboratory at Technical College, Mount Pleasant; borough architect.

Wolverhampton. — Extensions at Fallings Park for Guy Motors, Ltd.; McKeand, Smith & Co., Ltd., Showell Road, Bushbury, Wolverhampton.

Worthing.—Houses (88), Maybridge estate; borough housing architect, Town Hall.